ANNUAL REPORT

Science and Technology Project on Integrated Vector Control of Malaria, Filaria and Other Vector Borne Diseases

1992

MALARIA RESEARCH CENTRE
(Indian Council of Medical Research)
22-Sham Nath Marg
Delhi - 110 054

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Document for restricted circulation

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PREFACE

Malaria is endemic in India and its control has become problematical due to insecticide resistance in vector species, drug resistance in P. falciparum and resistance in man to allow their dwellings to be sprayed compounded by operational problems. Although it is feasible to control malaria by residual spraying of insecticides but the costs are enormous and non-affordable on sustained basis. Therefore, Science and Technology project on the integrated vector control of malaria, filariasis and other vector borne diseases launched in the country during the VI plan period has special significance. Studies have shown that the technologies developed and successfully demonstrated in various parts of the country have the potential to reduce or eliminate the role of residual insecticides in most situations. In areas where these technologies are not feasible it may be possible to bring about significant reduction in the application of insecticides. During this period Centre has gained experience so that it is possible to work out methods and strategies of malaria control by non-insecticidal methods of malaria control.

A unit of the MRC was opened in Bangalore city, Karnataka to transfer bioenvironmental malaria control strategy to cover the entire state of Karnataka. Jointly MRC, NMEP and state health department organized several training workshops to health staff of the state. Following this the scientific staff of the unit is visiting endemic PHCs and based on detailed epidemiological analysis and field visits villages which are responsible for maintaining high endemicity are identified. A geographical reconnaissance (GR) of these villages reveals the mosquito breeding sites. This information is passed on to the health department along with the recommendation on how to control mosquito breeding on long term basis. In many areas other sectors are also involved to control breeding. This programme will continue till such time that the entire state is covered by GR and recommendations are adopted for implementation by the health department. Simultaneously it is also proposed that the team will promote the breeding of larvivorous fishes and participate in organizing re-training courses to facilitate the transfer of technology. NMEP is currently engaged in malariogenic stratification of other states and as soon as the ground work is completed the project teams will move into that state to take up a similar exercise. Thus the process of gradual replacement of insecticides has already started. In urban areas in Madras city the technology of bioenvironmental malaria control is being extended to cover the entire city of Madras with the active support and help of NMEP and the state health department and Madras Municipal Corporation. During 1992, 0.1 million notices have been served on the residents to mosquito proof their water storage facilities. This effort is being augmented by the student

action plan to mosquito proof the mosquito breeding habitats. In Panjim, Goa intense malaria transmission has been curtailed to a point that malaria is no longer perceived a serious problem and field operations have been handed over to the health department. Similarly control of Industrial malaria is a successful story and the technology is being transferred to other industries through workshops while BHEL and IDPL are in the maintenance phase.

Programme of field research at all the field stations was revised and new projects launched following the successful demonstration of the bioenvironmental malaria control. Laboratory research is providing important inputs for the field programmes. Neem (Azadirachta indica) has been taken up for its value in vector control. Neem based insecticides when tested as larvicides provide good control of mosquito breeding. Neem oil is an excellent repellent which can be used for the protection from bites of haematophagus insects. A G-6-PD kit has been developed for field use. Sero-monitoring is used in studies on malaria endemicity and a kit for mosquito blood meal identification has been developed. Among the new technologies being developed for applied field research are the remote sensing and geographical information system (GIS) to be used in stratification and in the diagnostics of malaria epidemics. Meso-cyclopes have been cultured to control mosquito breeding in the contained waters and insecticide impregnated bednets and curtains have been developed for malaria control. Three major projects have been launched in the field (i) application of impregnated bednets in the control of malaria in the mining areas of Orissa. Studies on the impregnated curtains have been initiated in Mandla and Delhi (ii) mosquito breeding and methods of its control in riceland agro-ecosystems in Rourkela, Mandla, Haldwani and Delhi (iii) Large-scale field trials on the biocides (Bti and Bs) and in the control of mosquito breeding, impact on mosquito adult populations and impact on the transmission of malaria and filariasis. Studies on bio-larvicides are in progress at 7 field stations and in Shahjahanpur major spraying programme is in progress to study the impact on malaria and filaria. In addition training workshops were organised in various part of the country, new video programmes were developed and computers are being applied in stratification and mosquito identification.

The S&T project has been funded for the duration of VIII plan period and during this period we hope that bioenvironmental methods would be introduced in atleast 2 states and new technologies would be developed for cost-effective and sustainable malaria control in atleast some endemic areas of the country. A begínning has been made and we are hopeful that eventually insecticides would be replaced by the environmental methods to bring about sustainable malaria control at an affordable cost.

PART I (GENERAL PROJECT INFORMATION)

1. PROJECT TITLE:

Science and Technology Project on the Integrated Vector Control of Malaria, Filaria and Other Vector Borne Diseases

2. OVERALL OBJECTIVES:

(i) Integrated vector control of malaria and other vector borne diseases in different agro-climatic regions of the country under the influence of different vector species/parasites and other socio-economic problems.

(ii) Development of cost-effective model for extension and/or duplication in similar geographical areas of the country.

(iii) Environmental improvement.

(iv) Exploitation of hitherto untapped natural resources for income generating schemes to make the programme self sustaining with minimum government support.

ADDITIONAL OBJECTIVES (starting March 1989)

(i) District level implementation of the bioenvironmental control of malaria strategy in Gujarat and UP through the district infrastructure and primary health care system using existing resources and man power.

(ii) Preparation of mosquito control action plan for the entire metropolis of Delhi (UT) and Madras (TN).

(iii) Preparation of training manuals , video films and organization of training programmes for various categories of medical and para-medical officers, technicians, engineers, architects and officers of collaborating agencies.

(iv) Basic and applied research to support field activities.

3. NODAL DEPARTMENT WITH COLLABORATING AGENCIES:

Nodal department : Indian Council of Medical Research
Institute : Malaria Research Centre

Collaborating Agencies :

(i) National Malaria Eradication Programme (NMEP)
(ii) State Health Departments and Corporation/Municipalities
(iii) Local Institutions and other State & Central Govt. Departments

4. BUDGET:

(i) Organizationwise breakup of the cost, (yearwise) (as given in the project document)

	Rs. in Lakhs					
Agency	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
ICMR	110	110	110	110	110	110
Min H & FW	100	100	150	142.50	150	150
Total	150	210	260	252.50	260	260

*

(ii) Expenditure (Rs. in Lakhs)

	Items	1988-89	1989-90	1990-91	1991-92	1992-93
(i)	Pay & Allowances	63.97	78.22	106.08	106.80	125.66
(ii)	Transport & Equipment	63.88	28.95	24.17	29.59	9.39
iii)	TA/DA	10.41	9.30	10.54	10.44	10.68
(iv)	Other Charges	121.74	126.56	114.04	113.17	114.27
(v)	Capital	-	3.85	4.41	-	-
	Total	160.12	260.00	246.88	259.24	260.00

* For 1985-86, 1986-87 and 1987-1988 please see previous reports

(iii) STAFF POSITION OF S&T PROJECT

(as on 31.12.1992)

Name of Posts	Post sanctioned	Posted	Vacant/Excess
Financial Adviser	1	1	-
Officer on special duty	1	-	1
Dy. Director (Eng.)	1	-	1
Assistant Director (Eng.)	1	-	1
Sr. Research Officer	12	8	4
Research Officer	23	15	8
Asstt. Research Scientist/TO	25	22	3
Health Educator/ATO	21	16	5
Lab. Technician	43	43	-
Insect Collector	65	59	6
Field Lab. Attendant	95	88	7
Driver	48	62	+14
Upper Division Clerk	22	4	18
Administrative Officer	1	-	1
Accounts Officer	1	1	-
Section Officer	1	1	-
Sr. Personal Asstt/P.S.	2	-	2
Assistant	2	2	-
Junior Engineer	2	1	1
Asstt. Engineer	1	-	1
Supervisor	1	-	1
Sr. Stenographer	1	-	1
Jr. Stenographer	1	1	-
Artist	1	1	-
Photographer	1	1	-
Cameraman	2	1	1
Computer Programmer	8	7	1
Computer Operator	1	-	1
Production Assistant	1	1	-
Lower Division Clerk	24	24	-
Peon	17	13	4
Chowkidar	16	14	2
Sweeper	7	5	2
Mechanic (Electrician)	2	1	1
Draftsman	1	1	-
Duplicating Operator	1	1	-
Research Associate	3	-	3
Sr. Res. Fellow	6	2	4
Jr. Res. Fellow	6	-	6
	468	379	89

5. PROJECT MANAGEMENT STRUCTURE:

5.1 PROJECT MANAGER : Dr V.P Sharma, Director — Tel: 233743
Malaria Research Centre
22-Sham Nath Marg — Telex:031-78234
Delhi - 110 054 — Fax: 7234234

20, Madhuban — Tel: 2247983
Delhi - 110 092

5.2 COMPOSITION OF STEERING COMMITTEE :
(Meeting at six monthly intervals at the ICMR HQ's office)

Director General, ICMR
Additional Director General,ICMR
Senior Deputy Director General(Administration),ICMR
Financial Advisor, ICMR
Project Manager

5.3 COMPOSITION OF EXECUTIVE COMMITTEE :

Dr. V.P. Sharma, Chairman
Mr. R.K. Chandrahas (Madras)
Dr. Vas Dev (Sonapur)
Dr. V.K. Dua (Hardwar)
Dr. A. Giri (Car Nicobar)
Dr. A. Kumar (Goa)
Dr. R.P. Shukla (Haldwani)
Dr. R.N. Prasad (Shahjahanpur)
Dr. Neeru Singh (Jabalpur)
Dr. A.S. Gautam (Nadiad)
Dr. B. Shahi (Allahabad)
Dr. R.S. Yadav (Rourkela)
Dr. Anil Prakash (Bangalore)
Dr. Aruna Srivastava (Computer)
Mr. T. Adak (MRC, HQs and Delhi), Member Secretary
Administrative Officers (S & T project and MRC)

6. IMMEDIATE OBJECTIVES:

6.1 ACTIVITIES DURING THE YEAR 1992-93

STATE, GUJARAT

(I) Kheda district: (i) A genetic resource unit on larvivorous fishes of India and their potential in the control of mosquito breeding is being established. (ii) demonstration site on bioenvironmental strategy is being developed. (iii) training for medical and other staff of the district.

STATE, UTTAR PRADESH

(I) Allahabad (II) Hardwar (III) Nainital (IV) Shahjahanpur

In the above mentioned districts studies have been planned for (i) monitoring of drug resistance (ii) biological control of mosquito breeding (iii) epidemiology of malaria (iv) studies on rice agro ecosystem and (v) migration pattern.

DELHI, UNION TERRITORY

(I) Delhi (U.T.) (i) Malaria control action plan for Delhi is under preparation, (ii) Mass production of larvivorous fishes and their dissemination, (iii) a demonstration site is being developed for training purposes, (iv) Remote sensing for macro-stratification, and (v) Geographical Information System is being applied for malaria.

MADRAS, TAMIL NADU

(I) Madras (T.N.) (i) 7-point action plan is being implemented in Madras city, (ii) Student action group has been mobilized, and (iii) Bye-laws are being implemented.

STATE, MADHYA PRADESH

(I) Mandla district: The immediate objectives are (i) training of engineers, (ii) training of district officers, (iii) establishment of larvivorous fish hatcheries (iv) Work on deltamethrin and Lamdachylothrin impregnated bednets is in

progress, and (v) Work on distribution and occurrence of various plasmodium species is being emphasized.

STATE, ASSAM

(I) Kamrup district: Insecticide impregnated bednets programme is being expanded to cover larger areas in the state through the tribal welfare department. Mass production of larvivorous fishes is in progress. Health education is being emphasized. Studies have been initiated on the biology of An. minimus. Workshops on the serious and complicated malaria.

STATE, ORISSA

(I) Sundargarh district: Mass production of larvivorous fishes and control of mosquito breeding in rice fields, mining malaria is under study. Clinical research on malaria has been taken up with Ispat General Hospital. Application of bednets for malaria control.

ANDAMAN & NICOBAR ISLANDS, UNION TERRITORY

(I) Car Nicobar: Minor engineering works have been implemented to eliminate mosquito breeding in the island and B. sphaericus would be applied to eliminate the vectors from this island.

STATE, GOA

(I) Panjim district: In Panjim malaria control programme has been expanded to cover the entire town, courses are being offered to engineers, doctors, and action plan for Goa state is under preparation.

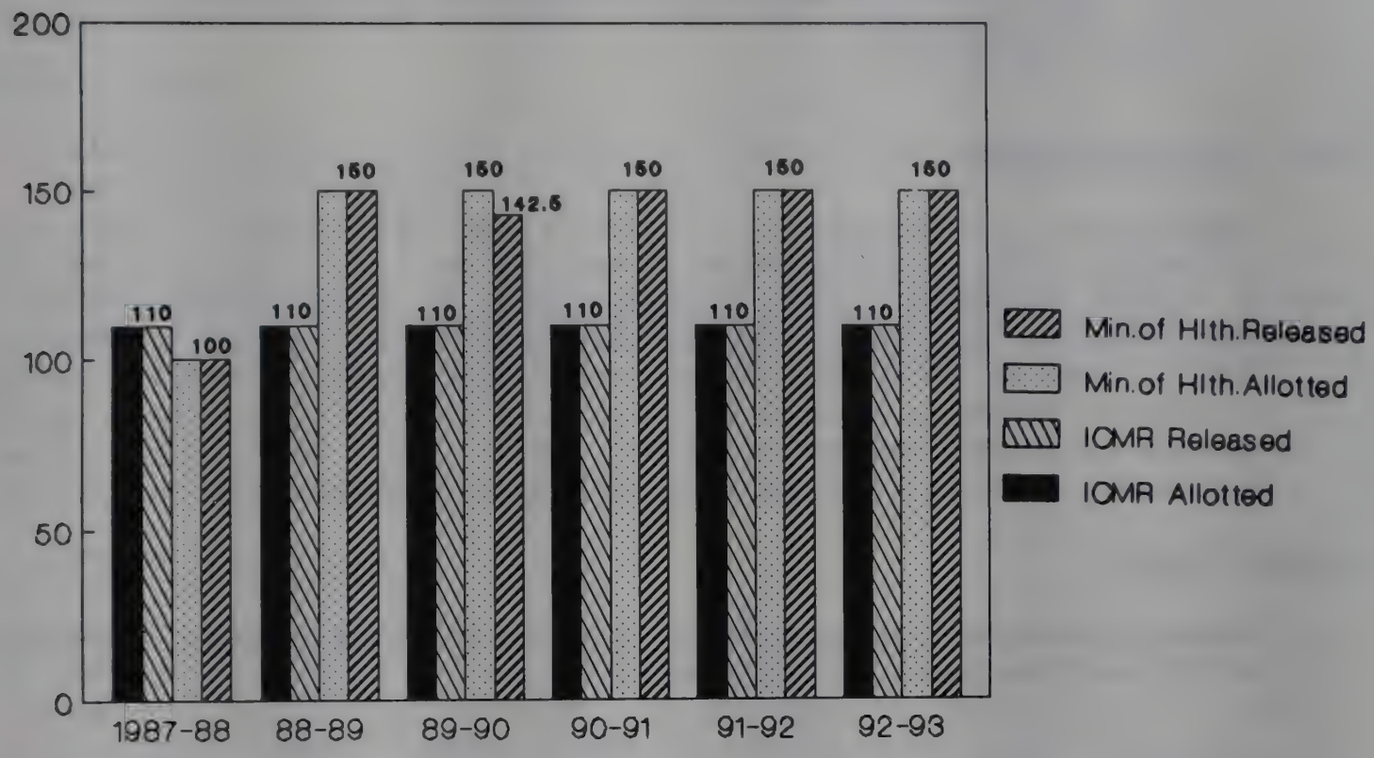
State Level Implementation

STATE, KARNATAKA

Bioenvironmental control of malaria is being implemented in the entire Karnataka state jointly by the NMEP/State Health Department and Malaria Research Centre. Training courses have been organized and a field station has been opened in Bangalore for the transfer of technology and to implement the strategy.

6.2 B.E. 1992-93 WITH FLOW OF FINANCE ANALYSIS

The analysis is given below which is self explanatory.



B.E. 1992-93 with Flow of Finance since 1987

Note: Additional grant of Rs. 2 Crore for construction work at the field stations would be required during 1993-94 financial year.

PART - II (SPECIFIC INFORMATION FOR MONITORING)

7. CARRIED OVER DECISIONS :

DECISIONS TAKEN IN THE REVIEW MEETING NO. 7 TAKEN BY SA TO PM ON JUNE-JULY 1989 AND FOLLOW UP ACTIONS TAKEN BY THE NODAL DEPARTMENT

(i) RECOMMENDATION :

Regarding project staff, it was agreed that FA, ICMR and Director, MRC would evolve a mechanism to solve the problem. A core staff of ICMR, as required at a particular field station and projected by the Project Investigator (Director, MRC), would be provided as regular staff of ICMR. Other project workers should be from the State Govts./NMEP on the basis of consolidated salaries etc. The core staff would be moved to new locations as and when necessary.

ACTION TAKEN :

Council has set up a screening committee to select projects which may be made permanent.

DECISIONS TAKEN IN THE REVIEW MEETING NO. 8 TAKEN BY MOS (S&T) ON 22ND JANUARY 1990 AND FOLLOW UP ACTIONS TAKEN BY THE NODAL DEPARTMENT,

The following decisions were taken:

(i) RECOMMENDATION:

Work on the district level implementation in U.P. and Gujarat should be vigorously pursued by the respective Health Departments. In Gujarat, one more district e.g., Surat, as selected by the State Government, may be selected for implementation. MRC will continue to provide technical inputs through its core technical/assisting staff.

ACTION TAKEN:

M.R.C. is continuously providing technical inputs to the programme for the implementation of bioenvironmental control but response from the states is not forthcoming.

(iv) RECOMMENDATION:

The role of remote sensing techniques in geographical reconnaissance, predicting mosquito population build up, and impending outbreaks of malaria, was highlighted. Arrangements would be made to develop linkages with remote sensing agency for application of this technology in mosquito control.

ACTION TAKEN:

Preliminary work has started. Some staff members have also received training.

DECISIONS TAKEN IN THE REVIEW MEETING NO. 9 TAKEN BY MOS (S&T) ON 13TH SEPTEMBER 1990 AND FOLLOW UP ACTIONS TAKEN BY THE NODAL DEPARTMENT,

The following decisions were taken:

(i) RECOMMENDATION:

Work at the district level implementation of the bioenvironmental control strategy should be taken up without further delay in UP and Gujarat. The Ministry of Health & Family Welfare would look into the planning, cost aspects and implementation mechanism etc. Initially, district level implementation would be treated as projects and a suitable mechanism would be evolved for the implementation to achieve the desired results, and from these areas NMEP operations of spraying would be withdrawn. Obviously, the implementation may not be strictly as per the existing primary health care system norms. State Govts. would be responsible for implementation and MRC will provide back up technical support.

ACTION TAKEN:

MRC is continuously providing technical inputs to the programme for the implementation of bioenvironmental control but response from the states is not forthcoming.

(iii) RECOMMENDATION:

Delhi site of the Science & Technology project which was till now kept separately from the Science & Technology project would be merged with the Science & Technology project along with its assets and finances etc.

ACTION TAKEN:

Delhi site has been merged with the S & T project.

(iv) RECOMMENDATION:

Core staff of the Science & Technology project should be identified by a group comprising Jt. Secretary (Health), FA (ICMR), Addln. Director General, (ICMR) and Director MRC. This core staff for each field station would be considered for regularisation as MRC staff. The proposal would be submitted to the Health Ministry as soon as possible and there would be no difficulty in the regularization of the staff.

ACTION TAKEN:

ICMR has initiated action.

8. NEW S & T INPUTS INCORPORATED IN THE PROJECT

As a result of basic and applied research the following technologies are being studied for application in the field.

(i) Meso-cyclopes are being evaluated for their potential in the control of mosquito breeding.

(ii) A new bio-control agent fungi has been discovered in Nadiad which provides very effective control of mosquito breeding. Further evaluations are in progress.

9. SPECIFIC EFFORTS FOR PRODUCTION/LARGE SCALE USES/ REPLICATION/ HORIZONTAL TRANSFER OF TECHNOLOGY

(i) Civil engineers, architects, town planners and health administrators are being trained by organising 3 to 5 day travelling workshops all over the country.

(ii) Video films on various field programmes have been produced which are being telecasted on the national network by Doordarshan.

(iii) Malariogenic stratification is being applied for withdrawing insecticidal spraying in most areas in Karnataka State. Bioenvironmental control of malaria is being introduced.

(iv) Additional health education material viz., folders, posters, charts, exhibitions and pamphlets etc., have been prepared for increasing awareness in the communities.

10. OVERALL ASSESSMENT OF THE PROJECT STATUS IN DEC, 1992

In terms of objective (i)

1. Kheda district, Gujarat: The monitoring system developed in Kheda has been tested, An. culicifacies bionomics is being studied in various ecosystems.

2. Shahjahanpur district, U.P.: P. falciparum resistance is being monitored. Fishes (Guppy and Gambusia) have been distributed all over the district and 10 kms beyond. Similarly breeding in wells has been controlled with EPS beads or by the application of fishes. Voluntary agencies are helping in the implementation of the strategy.

3. Hardwar district (BHEL+IDPL), U.P.: Industrial malaria control has been extended to Mathura and Tundla. Training programme on industrial malaria control is ready.

4. Haldwani, Nainital district, U.P.: Larvivorous and edible fish production is in progress. Health education has produced very useful results in terms of malaria control.

5. Allahabad district, U.P.: Labour migration has been studied with particular reference to P. falciparum.

6. Mandla district, M.P.: Research work is being intensified on forest related malaria. Studies on pyrethroid impregnated bednets have completed 2 years. There has been reduction in malaria transmission in the experimental villages.

7. Rourkela, Sundargarh district, Orissa: Insecticide impregnated bednets have successfully controlled malaria in areas with An. fluviatilis.

8. Goa, Panjim district, Panaji: Malaria in Panjim has been successfully controlled and transmission is mainly confined to the construction sites.

9. Kamrup district, Assam: Deltamethrin impregnated bednets have successfully interrupted transmission in villages with An. minimus and An. fluviatilis. The strategy is being propagated in the NE states.

10. Car Nicobar, A & N islands: Control of An. sundaicus has caused reduction in transmission and studies are in progress to eliminate vector breeding from the island.

11. Madras, T.N.: 7-point action plan for the control of malaria in Madras has been implemented. An. stephensi breeding in the experimental areas comprising of 6 corporation divisions was totally under control (200,000 population).

12. Delhi, U.T.: Malariogenic stratification of Delhi has been completed. Larvivorous fishes are being mass produced at the Seelampur farm. Fishes are being maintained in a large number of water bodies in Delhi.

13. MRC Hqs, Delhi: All support activities related to the S&T project have functioned extremely well. The main activities are (i) preparation of health education material (ii) video films (iii) training programme for engineers (iv) computerized data bank (v) preparation of manuals (vi) organising review meetings, visits etc. (vii) publications (viii) handling of administrative and financial matters.

In terms of objective (ii)

Development of a cost-effective model for extension and/or duplication in similar other geographical areas of the country.

Studies on the industrial malaria control revealed that the strategy is highly cost effective. Experimental areas are being expanded eg., entire Madras city and Karnataka state have been taken up for the bioenvironmental malaria control.

In terms of objective (iii)

The following schemes were encouraged:

(a) Social forestry and decentralized nurseries.
(b) Improved chulhas.
(c) Solar cookers.
(d) Sanitation programme.

In terms of objective (iv)

Exploitation of hitherto untapped natural resources as part of income generating schemes to make the programme self sustaining with minimum government support.

(a) Production of edible fishes with larvivorous fishes in village ponds.

(b) Plantations in wasteland are being maintained.

In terms of Additional objectives

(a) The strategy has been adopted in Karnataka. It is being extended to cover the entire state of Goa and Madras city is being taken up as a whole for malaria control.

11. B.E. 1992-93, R.E. 1992-93 AND THE ACTUAL EXPENDITURE

1992-93 (Rs in lakhs)

B.E.	450.00
R.E.	260.00
Actual expenditure	260.00 (Till Mar'93)

(See page 2)

12. PERFORMANCE

12.1 MRC HQs, DELHI

The following activities were carried out at the MRC HQs office.

(i) Central facility for data collection, analysis and retrieval.

(ii) Research support. Studies were done on personal protection methods.

(iii) Transfer of technology to the states.

(iv) Preparation of exhibitions, folders, and video films.

(v) Organizing project committee meetings.

(vi) Organizing visits of important scientists to the field stations.

(vii) Independent cross-checking of field activities and providing direction and mid-course correction.

(viii) Coordination and interface with different agencies.

(ix) Special studies in certain areas such as relapse pattern in P. vivax, drug resistance, migration, economic loss due to malaria, socio-logical studies and impact of health education etc.

(x) Fixing targets for each activity of the field stations.

(xi) Research publications, communications, and writing reports etc.

(xii) Recruitment, site selection and arranging major equipments etc.

(xiii) Organizing training courses : (i) training for the MRC staff on various subjects and (ii) training of engineers and architects..

12.2 WORK DONE IN FIELD STATIONS

(i) HARDWAR DISTRICT, U.P.

Bioenvironmental control of industrial malaria at BHEL, Hardwar and IDPL, Rishikesh are under maintenance phase. The implementation of bioenvironmental control strategy at Indian Oil Corporation, Mathura Refinery is in the first year of its full operation. The field station has received request from Bongaigaon Refinery and Petrochemicals Ltd., Assam to undertake survey of malariogenic potential in the complex. Efforts are being made to carry out survey in some other industries so that a larger population can be benefited by implementation of bioenvironmental control programme. Besides, more stress is being laid on research activities such as vector bionomics, evaluation of repellent action of Neem and other plants, biocide trials, determination of concentration of antimalarial drugs in different body fluids, determination of level of organochlorine insecticides in different components of the ecosystem.

BHEL, Hardwar : Anopheline breeding source surveys are being carried out to monitor recurrence of any temporary breeding place within the complex. The regular intervention activities are withdrawn and these are restricted to temporary breeding places caused due to leakages, blocking and overflowing of man-holes, rain water collections and intradomestic containers etc. Adult mosquito density is being monitored in experimental and control areas at fortnightly interval. Figure - 1 shows that vector density was maintained at low level in the experimental area as compared to control area since 1988 onwards which has been responsible for remarkably reducing malaria transmission in the complex.

More than 90% of the total density of An. culicifacies in the township is being contributed by seasonal river Ranirao during monsoon where bioenvironmental control strategy has very limited role. It is therefore imperative to seek some permanent solution for the control of riverine mosquito breeding.

The field station is maintaining an estimated stock of about 20 Lakhs larvivorous fishes viz; guppy and Gambusia which are providing excellent mosquito breeding control in all permanent water bodies such as storm water drains, effluent ponds, ornamental tanks and bigger underground tanks.

Results of active and passive surveillance for 1992 are given in Table - 1. During 1992 there were only 121 total malaria cases with a slide positivity rate (SPR) of 2.20% as compared to 327 cases (SPR=4.7%) during 1991. Only 3 P.

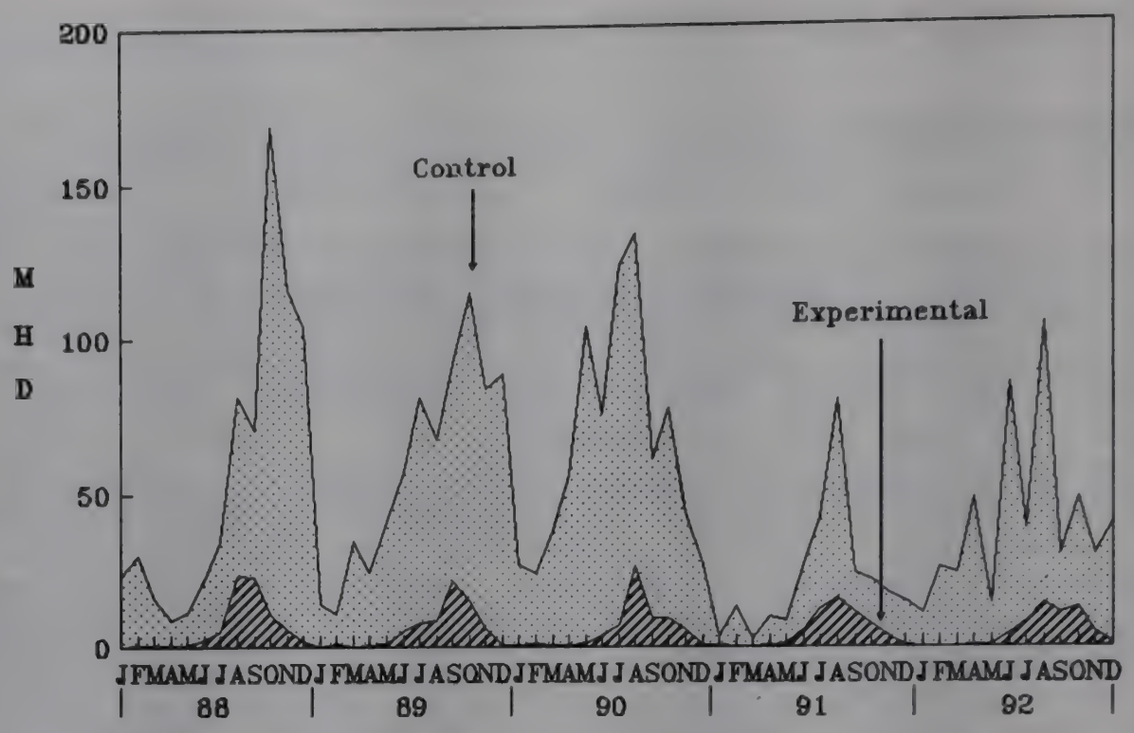


Fig. 1: HARDWAR: Vector density in experimental and control villages

TABLE 1:HARDWAR (BHEL): PARASITOLOGICAL DATA (1992)

Month	B.S.C	+VE	Pv	Pf	SPR
Jan	178	6	6	-	3.40
Feb	175	4	4	-	2.30
Mar	329	7	7	-	2.10
Apr	381	8	7	1	2.10
May	502	9	9	-	1.80
Jun	492	7	7	-	1.40
Jul	575	16	16	-	2.80
Aug	1100	12	12	-	1.10
Sep	993	35	35	-	3.50
Oct	410	13	13	-	3.20
Nov	159	2	2	-	1.25
Dec	136	2	-	2	1.50
Total	5430	121	116	3	2.20

falciparum cases were reported this year all of which were imported.

Follow-up of 1798 malaria cases from Jan 1988 to Dec 1992 (Table - 2) revealed that about 30% of the cases were from

Jwalapur and adjoining areas and 12% were imported from other parts of the country.

IDPL, Rishikesh : Malaria cases reported during 1992 at malaria clinic of MRC at IDPL hospital are given in Table 3. The data shows that there were only 57 total malaria cases and incidence of P. falciparum was nil. This is in comparison to 124 cases reported during 1991.

Mathura Refinery (Indian Oil Corporation): Integrated vector control programme is in full operational phase for the last one year. During this period breeding source surveys inside Mathura Refinery township and peripheral villages are being carried out at weekly intervals and positive breeding places are subjected to intervention measures which are carried out by refinery staff

TABLE 2 : HARDWAR : FOLLOW-UP OF MALARIA CASES AT BHEL (JAN 1988 To DEC 1992)

Total positive	BHEL Cases		Jwalapur	Miscellaneous
	+Ve	Imported		
1798	1298 (70.6%)	215 (12.0%)	306 (17.0%)	223 (12.4%)

TABLE 3: HARDWAR (IDPL): PARASITOLOGICAL DATA (1992)

Month	B.S.C.	Pv	Pf	+Ve	SPR
Jan	37	2	-	2	5.40
Feb	36	1	-	1	2.80
Mar	48	1	-	1	2.10
Apr	85	2	-	2	2.35
May	78	6	-	6	7.70
Jun	69	7	-	7	10.10
Jul	135	11	-	11	8.10
Aug	222	12	-	12	5.40
Sep	173	7	-	7	4.00
Oct	71	7	-	7	9.85
Nov	26	1	-	1	3.85
Dec	54	-	-	-	0.00
Total	1034	57	-	57	5.50

TABLE 4: HARDWAR (MATHURA): DENSITY OF ANOPHELINES AND VECTORS (1992)

Area	MHD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IOC, TOWNSHIP	TA	8.5	4.0	8.5	6.5	14.0	4.0	11.0	4.0	3.5	2.5	0.0	2.0
	VD	0.0	0.0	0.0	2.0	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
PERIPHERAL VILLAGES	TA	22.5	13.3	35.3	80.0	110.8	27.0	158.3	219.0	68.5	104.8	104.0	27.0
	VD	1.5	2.0	6.5	55.5	46.0	13.0	45.0	39.0	7.8	36.5	50.8	5.3

TABLE 5: HARDWAR (MATHURA REFINERY): PARASITOLOGICAL DATA (1992)

Month	B.S.C	Total +ve	Pv	Pf	SPR
Jan	253	14	11	3	5.53
Feb	218	4	4	-	1.83
Mar	260	8	8	-	3.10
Apr	283	6	5	1	2.10
May	267	32	32	-	11.98
Jun	401	40	40	-	9.97
Jul	336	48	48	-	14.28
Aug	627	44	40	4	7.00
Sep	1213	239	239	16	19.70
Oct	1332	382	245	137	28.70
Nov	986	222	157	65	22.50
Dec	561	97	26	71	17.30
Total	6737	1136	839	297	16.90

under the supervision of MRC. Vector breeding surveys revealed that river Yamuna passing at a distance of about 1 km from township area is the major source of An. culicifacies breeding besides other permanent water logged areas in the adjoining villages.

Results of monitoring of adult densities in the township and peripheral villages are given in Table - 4. Data shows that vector density (An. culicifacies and An. stephensi) is very low in the township area as compared to peripheral villages but in the absence of cattle population on the campus, the vector - man contact is more as observed during whole night human bait collections.

The results of active and passive surveillance (Table - 5) shows increase in the number of total malaria cases (1136) with slide positivity rate (SPR) of 16.90%. Comparison of malaria incidence in 1992 with that of 1991 (Total cases 406) shows unusual high malaria incidence during the year. It is important to mention that during 1992 the annual rainfall was maximum as compared to past ten years. Moreover, it was an extended monsoon and this area received good rainfall even in late October and mid November which favoured continued malaria transmission.

OTHER STUDIES:

Bionomics of An. fluviatilis : Studies on the bionomics of An. fluviatilis in the foothills of Shivalik range were completed at Bapu Gram (Rishikesh) and Ismilepur (Hardwar). Both the areas were selected keeping in view the high density of this vector species. The study involved extensive survey of breeding habitats, seasonal prevalence, human and cattle bait collections, analysis of blood meal for host identification and vector incrimination studies. The study indicated that it is a peri-domestic breeder and prefer indoor resting as compared to outdoor resting. The species is characterized by high densities, very low human blood index and zero infection rate, therefore, does not play any significant role in malaria transmission in this area.

Field studies to evaluate repellent action of Neem oil : Mosquito repellent action of Neem oil was evaluated on human and cattle population. 2% Neem oil mixed in Coconut oil was used for determining repellent action. Table - 6 shows results of the trials carried out on human baits in the evening collections. The study shows that 2% Neem oil was effective in providing 85% protection against Aedes 37.5% against Armigeres and 61% against Culex mosquito bites. All these mosquitoes are highly anthropophilic species and create a lot of nuisance.

TABLE 6 : HARDWAR: RESULTS OF FIELD TRIALS FOR EVALUATION OF MOSQUITO REPELLENT ACTION OF NEEM OIL* ON HUMAN

Number Bait	Aedes sp.	Armigeres sp.	Culex sp.	Total Mosquitoes sp.
Experimental	8	5	14	27
Control	55	8	36	99
% protection	85	37.5	61	73

* 2% Neem oil in Coconut oil.

TABLE 7: HARDWAR: RESULTS OF FIELD TRIALS FOR EVALUATION OF MOSQUITO REPELLENT ACTION OF NEEM OIL* ON CATTLE BAIT

Sl.	Species	Cattle Bait		% protection
		Experimental	Control	
1.	An. culicifacies	2	353	99.4
1.	An. fluviatilis	0	51	100
2.	An. stephensi	2	50	96
3.	An. annularis	1	174	99.4
4.	An. subpictus	0	4	100
5.	An. nigerrimus	0	8	100
6.	An. splendidus	0	64	100
	Total Anophelines	5	704	97
7.	Culex spp.	21	340	94
	Total mosquitoes	26	1044	97.5

* 2% Neem oil in Coconut oil

Similarly 16 cattle bait collections were carried out to study repellent effect on other anopheline species. Legs of experimental cattle bait were applied with a massage of 2% neem oil mixed in Coconut oil. The control cattle bait was given application of only Coconut oil. All mosquitoes probing to bite or biting the applied portion of the legs were captured with the help of suction tube. The results shows (Table - 7) that Neem oil provides 100% protection against An. fluviatilis, An. subpictus,

An. splendidus and An. nigerrimus whereas it is 99.4% effective against An. culicifacies and An. annularis and 96% against An. stephensi.

Drug analysis:

a) Quinine: Normal phase high performance liquid chromatographic method using dichloromethane - methanol - perchloric acid (1M) (100 : 9 : 0.4 V/V) at flow of 0.8ml/min. on zorbax-sil column with fluorescence detector (Ex = 350nm, Em = 418nm) has been developed for the separation of quinine and quinidine from other antimalarials. Extraction recovery, using 150µl (2M) NaOH and 6ml ethylene dichloride, of quinine for plasma, serum, red blood cells and whole blood (Spiked on filter paper) were 83, 82, 78 and 77 per cent respectively. Average quinine concentrations in plasma, serum and red blood cells of healthy and falciparum malaria cases after oral administration of two tablets of quinarsol (each tablet contained 150mg quinine) in morning and evening on Day 1 (D1) and Day 2 (D2) are given in Table - 8). It is clear that average concentrations of falciparum malaria cases were three to four times more as compared to healthy volunteers at the starting of treatment and the ratio of falciparum to healthy case reduced from 3.3 to 1.2 within 32 hours of treatment. Quinine level in plasma or serum of healthy cases significantly increased with time as compared to malaria patients while red blood cells quinine level in falciparum malaria cases decreased with treatment which indicate that elimination of quinine from red blood cells in falciparum malaria cases was faster than plasma or serum. Ratio of quinine level in plasma/serum to red blood cells varies from 3 to 7 times which implies that quinine accumulates very little in red blood cells as compared to plasma or serum.

b) Chloroquine: Thirty two P. falciparum infected cases were followed for in vivo chloroquine sensitivity test for 28 days after giving standard treatment. 26 cases were sensitive while 6 cases showed resistance of RI level. The mean chloroquine concentrations on Day 2 in plasma and red cells of sensitive cases were 0.64 and 1.59 µg/ml respectively while that of resistant cases were 0.10 and 0.30 µg/ml respectively. Chloroquine accumulation in sensitive cases was 5 to 6 fold more as compared to resistant cases (Table - 9) and was significantly different in spite of inter-individual variations. Significant difference was also observed for

TABLE 8 : HARDWAR: CONCENTRATION OF QUININE IN PLASMA, SERUM AND RED BLOOD CELLS IN HEALTHY AND FALCIPARUM MALARIA CASES *

Time (in hours) after initiation of treatment	Plasma		Serum		Red Blood cells	
	a Healthy	b Pf	Healthy	Pf	Healthy	Pf
2.3	1.60±0.20	5.30±0.60	1.40±0.11	4.60±0.47	0.46±0.22	1.52±0.52
8	3.70±0.42	5.38±0.71	3.42±0.55	4.52±0.70	0.50±0.22	1.24±0.40
18	4.60±0.62	5.62±0.48	3.82±0.38	4.62±0.65	0.52±0.16	1.20±0.38
26	4.20±0.48	5.84±0.29	3.12±0.25	4.92±0.57	0.56±0.18	1.10±0.32
32	5.00±0.64	6.22±0.75	3.62±0.52	4.82±0.48	0.50±0.32	0.84±0.48

* Concentration are in g/ml

a. Average of six healthy cases

b. Average of 20 falciparum malaria cases.

TABLE 9: HARDWAR: CHLOROQUINE AND DESETHYL CHLOROQUINE CONCENTRATION IN PLASMA AND RED BLOOD CELLS OF SENSITIVE AND RESISTANT *P.FALCIPARUM* CASES

Cases	Concentration µg/ml			
	Day 2		Day 7	
	Chloroquine	Desethyl Chloroquine	Chloroquine	Desethyl Chloroquine
Sensitive (n = 26)				
Plasma	0.64 + 0.15 - (0.44 - 1.02)	0.32 + 0.10 - (0.18 - 0.49)	0.23 + 0.09 - (0.14 - 0.52)	0.20 + 0.05 - (0.12 - 0.26)
Red Blood Cells	1.59 + 0.41 - (1.10 - 2.66)	0.61 + 0.12 - (0.42 - 0.83)	0.57 + 0.22 - (0.28 - 0.89)	0.29 + 0.15 - (0.14 - 0.62)
Resistant (n = 6)				
Plasma	0.10 + 0.06 - (0.06 - 0.18)	0.05 + 0.01 - (0.03 - 0.08)	0.066 + 0.06 - (0.03 - 0.12)	0.03 + 0.03 - (0.12 - 0.060)
Red Blood Cells	0.30 + 0.07 - (0.17 - 0.36)	0.12 + 0.05 - (0.45 - 0.15)	0.11 + 0.04 - (0.06 - 0.18)	0.08 + 0.02 - (0.05 - 0.12)

* Figures in the parentheses indicate concentration range in µg/ml.

Day 7 concentrations. The chloroquine to desethyl chloroquine concentration ratio varied between 2 to 3 for Day 2 and Day 7.

Insecticide Analysis: DDT and HCH are still the choice insecticides for the control of mosquito borne diseases in public

TABLE 10 : HARDWAR : CONCENTRATIONS OF HCH AND DDT RESIDUES IN SOIL *

Area	HCH				DDT				
	α HCH	β HCH	γ HCH	Total HCH	o-p DDE	p-p DDE	o-p DDT	p-p DDT	Total DDT
Mean±S.E.	0.28±0.07	1.00±0.27	0.97±0.18	2.26±0.55	1.07±0.38	1.78±0.60	0.27±0.14	0.55±0.23	3.68±0.74
BHEL (n = 14)									
Range	ND-1.00	ND-3.10	ND-2.00	0.30-4.00	ND-5.00	ND-8.80	ND-2.00	ND-3.30	ND-9.60
Mean±S.E.	2.84±0.80	54.69±28.8	3.58±1.73	61.12±29.2	5.27±1.1	76.91±24.5	26.44±15.3	161.92±104.4	270.51±34.3
Hardwar (n = 14)									
Range	0.50-9.70	4.30-362.1	ND-23.0	5.1-362.90	ND-11.9	9.6-324	ND-218.10	ND-1500	21.1-1833.7

ND :Not detectable
* = Concentrations are in µg/ml

TABLE 11: HARDWAR: CONCENTRATION OF HCH AND DDT RESIDUES IN WATER SAMPLES *

Area	HCH				DDT				
	α HCH	β HCH	γ HCH	Total HCH	o-p DDE	p-p DDE	o-p DDT	p-p DDT	Total DDT
Mean	ND	ND	ND	-	ND	ND	ND	ND	-
BHEL (n=5)									
Range	-	-	-	-	-	-	-	-	-
Mean±S.E.	0.060±0.02	0.048±0.01	0.07±0.03	0.18±0.05	0.01±0.00	0.01±0.00	0.01±0.00	0.04±0.02	0.07±0.03
Hardwar (n=5)									
Range	0.40-0.10	0.04-0.06	ND-0.15	0.08-0.25	0.06-0.02	0.003-0.02	ND-0.07	ND-0.02	0.01-0.12

ND : Not detectable
* : Concentration are in µg/L

health despite of being major pollutants due to their chemical nature to persist in the environment. Recently bioenvironmental control of malaria was implemented by Malaria Research Centre (ICMR) in 12 different parts of the country and successfully controlled malaria without using any insecticide for more than five years. Therefore, the level of insecticides in different components of ecosystem in two control strategic areas would be important to find out.

Samples of soil, water and whole blood were collected from BHEL, Ranipur (Bioenvironmental methods) and Hardwar (chemical methods). Samples were extracted using n-hexane, benzene, acetone and methanol as extracting solvents and passed through silica or alumina column after drying for cleanup from co-extractive impurities. Concentrated samples were run on 5890 A Gas Chromatograph using nitrogen as carrier gas at flow of 120 ml/min. on 5% OV-17 column and insecticides were detected on

electron capture detector (Ni source).

The average (n=5) percentage recoveries of DDT and its metabolites and HCH isomers in soil, water and whole blood were more than 90% in all cases. Table-10 shows the residual levels of HCH isomers, DDT and its metabolites in soil samples taken from two strategic areas of malaria control i.e. i) BHEL (bioenvironmental methods and ii) Bahadrabad (insecticide sprayed). The mean concentrations of HCH and DDT in soil of BHEL were 2.26 (range 0.30-4.0) and 3.68 (range N.D.-9.6) g/kg while in Bahadrabad it were 61.12 (range 5.1-362.9) and 270.51 (range 21.1-1833.7) g/kg respectively. HCH was 44% in BHEL and 89% in Bahadrabad of total HCH present in particular area. Similarly p-p DDT and p-p DDE contributed 14.9% and 48% in BHEL and 59.8% and 28% in Bahadrabad respectively of total DDT present.

Results of water analysis for HCH and DDT residues in both strategic areas are given in Table - 11 which clearly shows that no HCH and DDT were detected in any water samples from BHEL indicating that these insecticides did not reached up to ground water. However, mean concentrations of HCH and DDT in Bahadrabad were 0.18 (range 0.08 - 0.25) and 0.07 (range 0.01 - 0.12) g/L respectively. The levels of -HCH and p-p DDT were 26.6% and 57% of total HCH and DDT present. The run-off water from surface soil, extensive use in malaria control programme and atmospheric contamination are responsible for their presence in Ganga water thereby detected in water samples of Bahadrabad area.

Concentrations of HCH and DDT residues in whole blood from two areas are given in Table - 12. The mean concentration of HCH in BHEL was 1.2 g/L with - HCH of 90% while in Hardwar it was 24.3 g/L with -HCH of 56% of total HCH present in respective

TABLE 12: HARDWAR: CONCENTRATIONS OF HCH AND DDT RESIDUES IN HUMAN BLOOD *

Area	HCH				DDTE		
	α HCH	β HCH	γ HCH	Total HCH	o-p DDE	p-p DDE	Total DDT
Mean±S.E.	0.80±0.01	1.09±0.09	0.03±0.01	1.20±0.13	ND	4.71±1.50	4.71±1.50
BHEL (n=19)							
Range	0.03-0.29	0.30-2.57	ND-0.27	0.44-3.16	-	ND-25.00	ND-25.00
Mean±S.E.	5.36±2.10	13.6±3.86	5.31±3.50	24.3±8.65	4.23±1.67	33.90±6.36	38.13±7.45
Hardwar (n=17)							
Range	0.04-31.25	0.19-3.86	ND-59.14	0.25-129.3	ND-17.45	4.33-81.90	4.33-90.75

ND : Not detectable
* : Concentrations are in μg/L

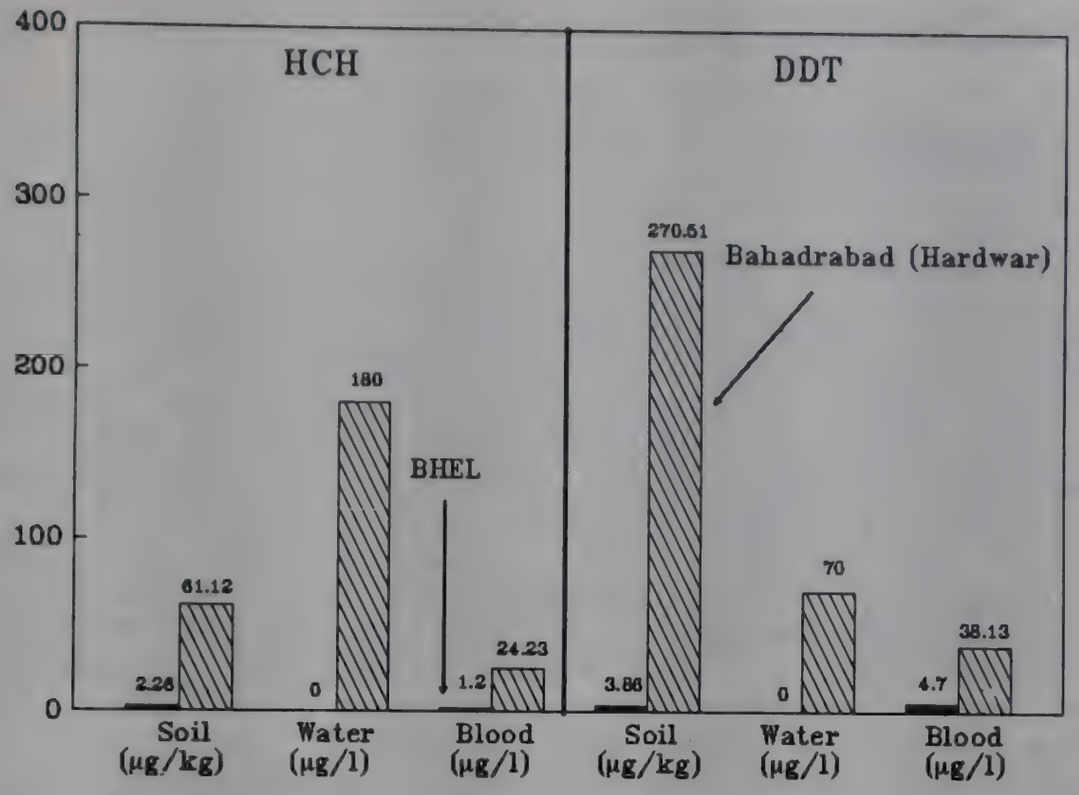


Fig. 2: HARDWAR: HCH and DDT residues in BHEL and Bahadrabad

areas. Similarly mean concentrations of DDT were 4.71 and 38.13 g/L in BHEL and Bahadrabad respectively. HCH concentration range varied from 0.44 to 3.16 g/L in BHEL and 0.25 to 129.3 g/L in Bahadrabad while DDT concentration ranged from ND to 25.00 g/L in BHEL and 4.33 to 90.75 g/L in Bahadrabad -HCH was found very little in both study area while p-p DDT was not detected in any sample.

A comparison of HCH and DDT residues in two strategic areas i) Bahadrabad (insecticde sprayed) and BHEL (bioenvironmental) are given in Figure 2. It is clear that the levels of HCH and DDT in soil samples from Hardwar were 27 and 74 times higher and in whole blood, it were 20.3 and 8.1 times higher as compared to their corresponding values from BHEL. No HCH and DDT was detected in water from BHEL while their mean concentrations in Bahadrabad were 0.18 and 0.07 µg/L respectively.

Statistical comparison of the residual level of DDT in soil and whole blood from two different strategic areas showed the significant difference in the mean values ($t_{(soil)} = 1.126$, $p < 0.05$: $t_{(blood)} = 4.603$, $p < 0.001$). Significant difference was also observed for HCH residues in soil and blood from BHEL and Hardwar area ($t_{(soil)} = 2.060$, $P < 0.05$: $t_{(blood)} = 2.785$, $p < 0.01$).

(ii) HALDWANI, NAINITAL, U.P.

IRRIGATION MALARIA :

Malaria has increased manifold in the wake of new irrigation project. A number of artificial water resources in the form of water reservoirs are made in terai area for irrigation. In such areas malariogenic conditions persist mainly due to irrigation networks consisting of reservoir, its canals and tributaries, seepage pools etc. Haripura reservoir is one of the five big water reservoirs of terai on the downstream of river Bhakra, with a dam length of 7.9 km and catchment area of 297.85 sq km. which irrigates 20,000 hactare land. Studies were undertaken on Haripura reservoir and its nearby areas from August 90 to July 92, to understand the role of irrigation, vector breeding and transmission of malaria. The entomological and epidemiological parameters were monitored in six villages i.e. four villages (population = 1390) near the reservoir and two villages (population = 972) about 8 km away from the reservoir.

ENTOMOLOGICAL OBSERVATIONS:

During the period, larval and adult densities of anophelines were recorded regularly, on monthly basis. The major breeding sites near the reservoir were seepage canal, seepage pit, irrigation canal, reservoir proper, river and artesian wells. While away from the reservoir mainly artesian wells and river stream were the sites for breeding. The larval densities recorded as per standard dip method revealed a high breeding potential near the reservoir throughout the year except during the month of April, 91. A total of 10 species of anophelines emerged out of 7053 larvae collected from six breeding habitats near the reservoir. Highest per cent (33.6%) of An. culicifaciès density was recorded near reservoir area followed by An. annularis (31.1%), An. fluviatilis (16.1%), An. subpictus (10.7%) An. splendidus (2.5%), An. vagus (1.9%), An. maculatus (1.8%), An. barbirostris (1.7%), An. nigerrimus (0.6%) and An. gigas (0.01%). In villages away from reservoir 9 species emerged out of 1371 larvae collected from 4 breeding sites viz., An. culicifacies (41.7%), An. fluviatilis (34.9%), An. annularis (10.4%), An. subpictus (4.4%), An. barbirostris (2.9%), An. maculatus (1.5%), An. splendidus (1.5%), An. vagus (1.5%) and An. nigerrimus (1.2%). Among two confirmed vectors viz. An. culicifacies and An. fluviatilis it was observed that river contributed more An. culicifacies (77.7%) near the reservoir throughout the year.

Man hour density of indoor resting anophelines were recorded in the morning collection from human dwellings and cattlesheds during the investigation period. Nine anopheline species viz. An. culicifacies, An. fluviatilis, An. annularis, An. subpictus, An. splendidus, An. barbirostris, An. maculatus, An. niggerimus and An. vagus were recorded and their per cent compositions are shown in Table 1. An. culicifacies was predominant species in both the area. The per cent compositions of vector species of An. culicifacies and An. fluviatilis near the reservoir were recorded 34.8 and 15.1 and away from reservoir these were 43.3 and 33.5, respectively. The densities of An. culicifacies and An. fluviatilis were many folds higher in villages near reservoir than away from the reservoir. In An. culicifacies peak density (89) was observed in the month of September and lowest in October to March in the villages near and as well as far away from the reservoir whereas density of An. fluviatilis near reservoir was extremely high and peak density (114.3) was observed in the month of February and low density was observed from May to September (Fig.1).

EPIDEMIOLOGICAL OBSERVATIONS :

Monthly surveillance of fever cases revealed that malaria incidence was much higher in villages near reservoir than the villages away from reservoir. During the study period, in the villages near and away from reservoir, the SPR was 22.1 and 11.7 whereas the SfR was 8.5 and 2.9, respectively (Table 2). This was mainly due to vast breeding surface area, high breeding potential and the vector density near the reservoir.

STUDIES ON RICE LAND AGRO-ECOSYSTEM IN TERAI AND BHABAR AREAS OF DISTRICT NAINITAL:

To reveal the underlying ecological and epidemiological mechanism of malaria transmission in association with irrigated rice land agro-ecosystem studies were planned in collaboration with G.B. Pant University of Agriculture and Technology, Pant Nagar. Preliminary surveys were conducted to know the varying farms and agronomic practices and thereafter rice fields were selected from two different areas viz. terai and bhabar for observing the entomological and epidemiological parameters. The two areas represent distinct eco-geographical characteristics, and human settlements with various breeding grounds and mosquitogenic conditions. In Bhabar soil is sandy loam and dry with low water table, scattered settlement and low agriculture yield whereas in terai, soil is clay loam and low-land are with high water table, agglomerated population and mechanised farming

TABLE 1: HALDWANI: PER CENT COMPOSITION OF INDOOR RESTING ANOPHELINES

Anopheline Species	Near reservoir Nos. (%)	Away from reservoir Nos. (%)
An. culicifacies	2612 (34.8)	620 (43.3)
An. fluviatilis	1136 (15.1)	480 (33.5)
An. subpictus	967 (12.9)	61 (4.2)
An. nigerrimus	44 (0.6)	17 (1.2)
An. barbirostris	120 (1.6)	40 (2.8)
An. annularis	2194 (29.2)	153 (10.7)
An. maculatus	144 (1.9)	21 (1.5)
An. splendidus	196 (2.3)	20 (1.4)
An. vagus	116 (1.6)	20 (1.4)
Total	7509	1432

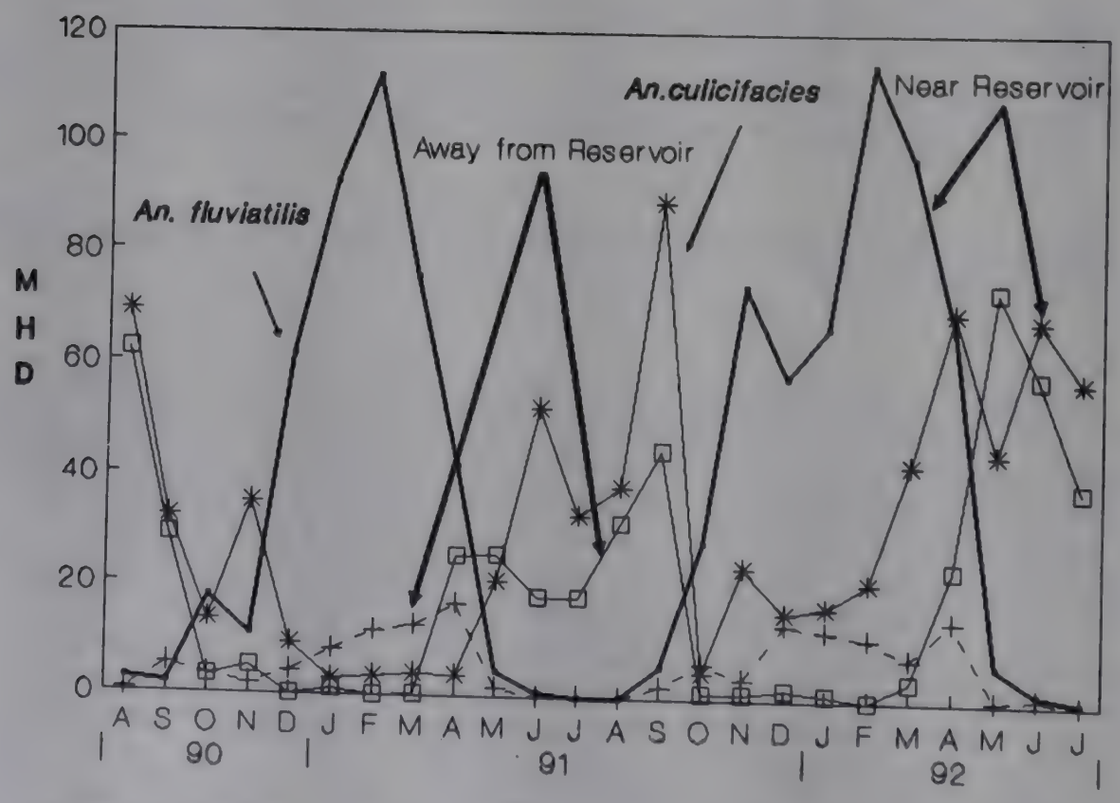


Fig. 1: Haldwani: Man hour density of An. culicifacies and An. fluviatilis

TABLE 2: HALDWANI: EPIDEMIOLOGICAL DATA FROM THE VILLAGES NEAR AND AWAY FROM HARIPURA RESERVOIR

YEAR	NEAR RESERVOIR (Population - 1390)							AWAY FROM RESERVOIR (Population - 972)						
	BSE	Pv	Pf	Total	SPR	SfR	PI	BSE	Pv	Pf	Total	SPR	SfR	PI
1990 (Aug - Dec)	109	10	15	25	22.9	13.7	17.9	57	2	3	5	8.7	5.3	5.1
1991	309	42	25	67	21.6	8.1	48.2	104	9	3	12	11.5	2.9	12.3
1992 (Jan - Jul)	74	15	2	17	22.9	2.7	12.2	44	7	-	7	15.9	-	7.2
Total	492	67	42	109	22.1	8.5	78.4	205	18	6	24	11.7	2.9	24.6

TABLE 3: HALDWANI: DETAILS OF THE PLOTS FOR RICE LAND AGRO-ECOSYSTEM STUDY

Area	Site	Rice variety	Fertilizer	Nos. of Plots
TERAI	Shantipuri No. 3	Indrashan	NPK & Urea	4
		Indrashan	Urea	1
		7112 (CR-44)	NPK & Urea	3
		Pant - 4	Urea	2
	Pant Nagar University	Jaya	DAP & Urea	6
		Pant Dhan - 4	Urea	6
		Multiple Entry	DAP & Urea	6
		Kasturi	DAP & Urea	32
	Bhawani Singh Newar	Manhar	Urea	6
		Sabarmati	Urea	4
BHABAR	Himmat Pur Chammuval	Pant - 4	Urea	3
		Sita	Urea	1
		Sita	Compost	1
		Tilak chandan	Urea	1
		China - 4	Urea	1
		CR - 44	Urea	1
	Total	10 varieties	4 fertilizer combination	78

TABLE 4: HALDWANI: DENSITY OF MOSQUITO LARVAE IN RICE FIELDS

Months 1992	LARVAE / DIP					
	BHABAR			TERAI		
	Anophelines	Culicines	Total	Anophelines	Culicines	Total
July	3.3	1.9	5.2	0.8	4.7	5.5
August	1.0	0.6	1.6	1.5	3.0	4.5
September	0.2	0.2	0.4	0.6	0.7	1.3
October *	-	-	-	1.1	0.6	1.7

* Paddy fields of bhabar were dry in October

Crop was harvested in November

resulting in high agricultural yield. Surveys in Bhabar area in two villages viz., Himmatpur Chammuval and Bhawani Singh Newar were carried out revealing a total population of human (680), bovines (545) and dwellings (117) whereas in terai area in Shantipuri No.-3 and CRC labour colony of Pant Nagar a total population of human (1238), bovines (1145) and dwellings (248) were recorded. The major breeding sites in peridomestic are tanks, pokhars, irrigation canals in Bhabar and artesian wells, seepage streams, drains, wells, septic tanks and river in terai. BHC and DDT were sprayed in above villages of Bhabar and Terai areas respectively during the period. A total of 78 fields with 10 rice varieties and different fertilizer usages selected for studies are shown in Table 3.

Entomological investigations: To correlate adult densities with immatures, larval collections were made in the peridomestic sites and rice fields during the cropping season. In rice field, anopheline larval density was 4 folds higher in July in bhabar area whereas in rest of the months its density was more in terai area (Table 4). In peridomestic sites anopheline larval density was nearly equal or higher in bhabar area than to terai throughout study period. The high density of An. culicifacies in indoor resting spray collections during August in bhabar area substantiated with a high anopheline larval density in peridomestic sites.

Monthwise species succession pattern of anopheline in rice fields and peridomestic sites are shown in Table 5. This revealed that like higher adult An. culicifacies density, the per cent composition of the same was also high in the immature collections of bhabar area in August in rice field than to terai area. During the vegetative growth of the plants in the first two months An. culicifacies composition showed a decline and was replaced by An. subpictus, which were observed in both the areas, but in later months, breeding shifted from An. subpictus to An. nigerrimus. Similar observations were also recorded in peridomestic sites but An. niggerimus composition was high in the terai area. As regard to occurrance of An. fluviatilis, rice fields were contributing 1.9 per cent in the month of September in terai area, whereas peridomestic sites were contributing 6.2 per cent during the month of November in bhabar area. In concurrence with rice field, peridomestic site also contributed a high per cent of An. culicifacies in bhabar than to terai area during August. Summarizing the species breeding prevalence during the whole rice cropping season, it appeared that An. culicifacies and An. annularis were more prevalent in bhabar area than to terai. However, between the two breeding grounds the contribution of peridomestic sites for An. culicifacies was nearly four folds and two folds higher in terai and bhabar areas, respectively as compared to rice field (Fig. 2). Physico-chemical properties of water constitute an important factor in

TABLE 5: HALDWANI: PER CENT COMPOSITION OF ANOPHELINES IN RICE FIELDS AND PERIDOMESTIC SITES OF BHABAR AND TERAI AREA

AREA	Months 1992	PER CENT SPECIES COMPOSITION							
		An. culicifacies	An. fluviatilis	An. subpictus	An. annularis	An. nigerrimus	An. barbirostris	An. vagus	An. maculatus
Rice field									
BHABAR	Jul	32.2	-	36.8	31.0	-	-	-	-
	Aug	13.1	-	84.8	2.1	-	-	-	-
	Sep	-	-	-	-	100	-	-	-
TERAI	Jul	18.1	-	58.7	23.2	-	-	-	-
	Aug	1.8	-	92.8	1.4	2.9	0.2	0.9	-
	Sep	1.0	1.9	74.2	4.8	18.1	-	-	-
	Oct	10.0	-	5.0	10.0	60.0	5.0	5.0	5.0
Peridomestic sites									
BHABAR	Aug	86.8	-	13.2	-	-	-	-	-
	Sep	36.8	-	63.2	-	-	-	-	-
	Oct	23.7	-	38.2	9.1	3.6	12.7	9.1	3.6
	Nov	25.0	6.2	62.5	-	6.3	-	-	-
TERAI	Jul	75.0	6.2	62.5	-	-	-	-	-
	Aug	5.5	-	81.8	12.7	-	-	-	-
	Sep	5.0	-	86.7	6.7	-	-	1.6	-
	Oct	-	-	36.0	12.0	44.0	4.0	-	4.0
	Nov	16.7	-	16.7	-	58.3	8.3	-	-

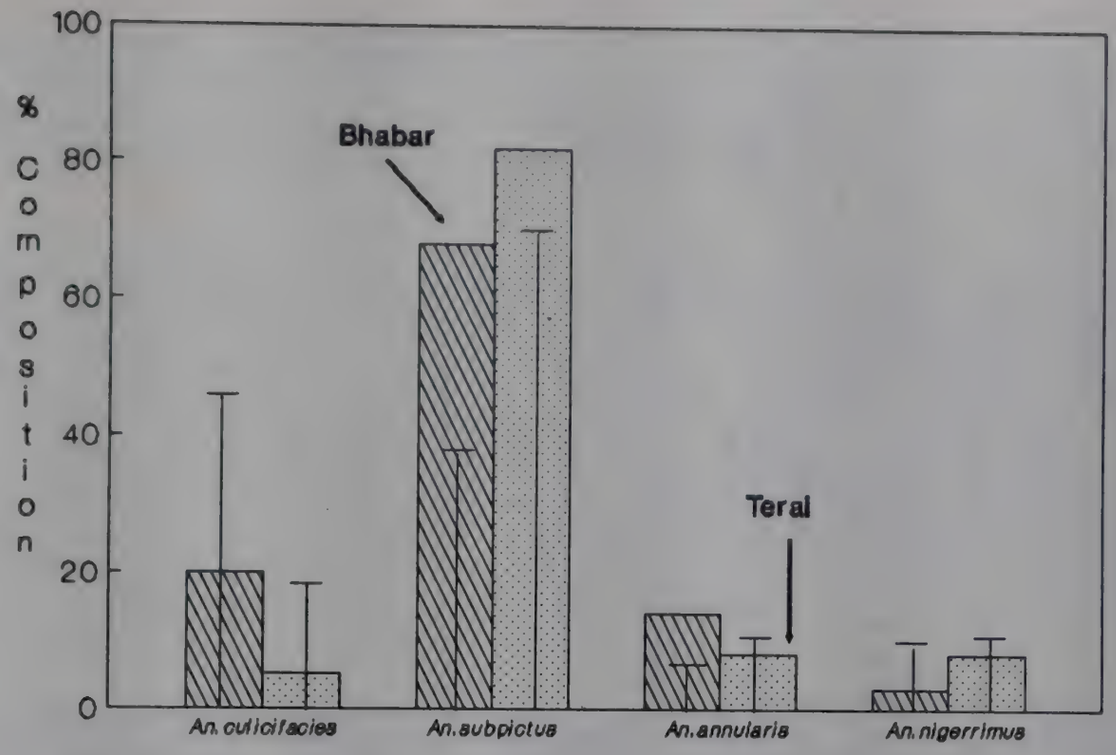


Fig. 2: Haldwani: Per cent composition of major Anophelines

supporting mosquito breeding. The water samples of rice fields were analysed by titration methods for dissolved O2, free CO2, total alkalinity, ammonia nitrogen and chloride content. Results of monthly variation of these chemical parameters in both the areas are shown in Table 6. The average value of total alkalinity, ammonia nitrogen and chloride content were high in terai area as compared to bhabar, which might be the reason for high culicines density in terai.

Succession of anopheline species in different rice varieties in association with physico-chemical parameters, period and dosage of fertilizer, insecticide and herbicide applications, appearance of vegetative growth etc. were observed in all rice fields of terai and bhabar areas. The data revealed that larval density was recorded high in the early stage of rice growth which gradually declined at later stages of plant growth. Distribution of vector species of An. culicifacies and An. fluviatilis appeared at different stages of rice growth. During early stage of rice (32 cm to 38 cm) An. culicifacies was predominant whereas in later stage (more than 70 cms) An. fluviatilis breeding was observed. Further, it was recorded that the rice fields treated with Butachlore and Endosulphan (Thiodane) @ 1 lt./acre 3 days and 24 days after transplantation, respectively showed low larval density for few days. Results of chemical analysis of water samples reflects that high ammonia nitrogen content had a reciprocal relation with An. culicifacies.

TABLE 6: HALDWANI: VARIATION OF CHEMICAL PARAMETERS OF WATER IN RICE FIELDS

AREA	Months 1992	CHEMICAL PARAMETERS					
		pH (Range)	Dissolved oxygen (ppm)	Free CO_2 (ppm)	Total alkalinity (ppm)	Ammonia nitrogen (ppm)	Chloride (ppm)
BHABAR	Jul	-	-	-	-	-	-
	Aug	7.0 - 8.0	7.6	6.1	104.3	0.032	10.5
TERAI	Jul	6.5 - 9.0	9.4	0	137.0	0.040	-
	Aug	6.5 - 8.0	6.9	6.0	190.4	0.368	14.8

Epidemiological investigations: Slide positivity rate (SPR) in terai and bhabar areas was 8.0 and 3.0 per cent respectively, showing higher malaria incidence in terai than in bhabar, whereas slide falciparum rate (SfR) was nearly equal in both area (Table 7).

Predatory potential of Cybister Larva: During the survey of natural enemies of mosquito larvae in rice fields, larvae of Cybister (Coleoptera : Dytiscidae) were collected and their predatory potential against mosquito larvae were studied in laboratory. Preliminary observations revealed that the predation rate varied from 64-89 mosquito larvae/24hr, when the predator size was upto 3 cm x 0.30 cm and later declined gradually with the growth of the predator, showing high predatory potential of the young Cybister larva. Further studies are in progress to determine the life-cycle of the predator and its larvivorous efficacy during different stages.

Coelomomyces infection in Anopheline larvae of rice fields : The entomopathogenic aquatic fungi belonging to the genus Coelomomyces are considered as potential biological agent for control of mosquito larvae. A total of 603 larvae belonging to 8 species of anophelines were examined for Coelomomyces infection. Out of 8 species of anopheline only 3 species ie. An. culicifacies, An. subpictus and An. annularis were found infected with Coelomomyces. High infection rate was recorded in An. culicifacies (17.1) and An. subpictus (47) in bhabar and terai area, respectively. However, an over all infection rate was (34.8) in An. subpictus followed by An. culicifacies (9.2) and

TABLE 7: HALDWANI: EPIDEMIOLOGICAL DATA DURING RICE LAND AGRO-ECOSYSTEM STUDY

Month	TERAI AREA (Pop. - 1238)					BHABAR AREA (Pop. - 680)				
	BSE	Pv	Pf	SPR	SfR	BSE	Pv	Pf	SPR	SfR
Jul	33	1	-	3.0	-	27	1	-	3.7	-
Aug	47	2	-	4.2	-	21	1	-	4.7	-
Sep	18	5	-	9.4	-	36	1	-	2.8	-
Oct	15	1	1	13.3	6.7	28	-	-	-	-
Nov	6	-	-	-	-	13	-	1	7.7	7.7
Dec	5	-	-	-	-	6	-	-	-	-
Total	124	9	1	8.0	0.8	131	3	1	3.0	0.7

TABLE 8: HALDWANI: RESULTS OF CULICINE DENSITY DURING FIELD TRIAL STUDY WITH ENITHERAS INDICA

Day of observation	Density in experimental tank						Density in control tank	
	3.5 bugs/m2		9.2 bugs/m2		15.6 bugs/m2			
	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae
0 day (Pre-treatment)	258.0	7.4	412.4	6.4	112.6	5.0	222.1	44.1
1 day (Post-treatment)	66.2 (69)	16.0 (-93)	60.0 (82)	14.0 (-95)	47.1 (50)	7.7 (-37)	184.6	49.5
2 day "	125.2 (48)	31.8 (-378)	59.8 (85)	17.2 (-199)	67.3 (36)	6.7 (-49)	209.0	39.6
3 day "	32.2 (85)	4.6 (4)	56.8 (84)	8.8 (-112)	22.4 (76)	3.4 (-5)	188.4	28.6
4 day "	24.4 (88)	3.2 (-64)	24.2 (92)	5.4 (-220)	16.6 (81)	1.5 (-14)	173.1	11.6
5 day "	18.4 (91)	2.2 (74)	14.8 (96)	4.6 (37)	26.4 (71)	2.5 (56)	180.0	50.6
6 day "	4.4 (98)	3.4 (52)	13.0 (95)	5.0 (18)	9.0 (88)	3.5 (27)	153.4	42.1
7 day "	6.4 (97)	2.6 (42)	8.2 (98)	1.6 (59)	6.2 (94)	2.0 (34)	211.4	26.6
14 day "	8.8 (95)	1.2 (88)	3.8 (99)	2.0 (77)	13.0 (82)	- (100)	141.9	60.4
21 day "	10.6 (93)	1.2 (81)	7.4 (97)	0.28 (95)	25.7 (63)	0.85 (80)	137.3	38.3

Figures in parentheses show per cent reduction in density of control

An. annularis (2.7). In terai area, the infection rate was four-fold higher as compared to bhabar area.

BIOLOGICAL CONTROL AGENTS :

Larvivorous fish (Gambusia affinis): Larvivorous fishes are being maintained in over 162 stocks of fish farmer's composite ponds, lakes and reservoirs of the District Nainital, where nearly 200 millions Gambusia fishes are stocked. Due to constraints in IDVC activity introduction of these fishes in breeding sites were restricted, even then approx. 2.6 lakhs of Gambusia fishes were introduced in various breeding sources viz. water reservoirs and ponds. Gambusia fishes were also supplied to various government agencies/departments.

Notonectid Bug (Enitheras indica) : Bugs have often been reported to be predators of mosquito larvae. Therefore, to evaluate predatory potential of these bugs, studies were carried out in laboratory and field conditions.

i) Laboratory study : Nymphs were provided instars of mosquito larvae under laboratory conditions, and corrected larval mortality were recorded at every 24 h. The average number of larvae consumed/24h/nymph, varied from 19.0 to 37.5. The predation rate increased as nymph grew from I to III stage becoming static from III stage onwards. The predation rate of young nymphs were more to I and II instar mosquito larvae in comparison to III and IV instars. A single IV stage nymph preyed upon 54 anopheline larvae in 24 h. There was no host preference.

ii) Field study : The experimental tanks measuring 1.4, 2.7 and 3.2 sqm and one control tank measuring 2.1 sqm in surface area were selected for the study. During pre-treatment period, larval (1st to 4th instars) and pupal densities of culicines were recorded as shown in Table 8. Bugs were released in the experimental tanks @ 3.5, 9.2 and 15.6 bugs/sqm, whereas no bugs were released in the control tank.

During post-treatment period, larval and pupal densities were recorded every 24 hrs., for the first seven days and later on weekly intervals upto 2 weeks. Per cent reduction of density over the control was calculated as per Mulla's formula (1971). In all the three tanks the bugs showed good response in controlling culicine larvae, however in tank where 9.2 bugs/sqm were released the results were very promising showing 82 per cent reduction on day 1st and 97 per cent on day 21st in culicine larval density. Observation further revealed a gradual reduction in pupal density afer 4 days which indicates preference of nymph to the larval instars than to pupae.

TABLE 9: HALDWANI: PARASITIC RELAPSE FREQUENCY OF P. VIVAX DURING 12 MONTHS

Therapeutic dosage	Year	Cases studied	Relapse frequency (%)			Relapse rate
			One relapse	Two relapse	Three relapse	
Chloroquine 900 mg Primaquine 75 mg	Jan 88 - Dec 89	1292	159 (12.3)	22 (1.7)	-	14.0
Chloroquine 900 mg	Nov 90 - Oct 92	67	21 (31.3)	6 (8.9)	3 (4.4)	44.8

TABLE 10: HALDWANI: MALARIA CASES AT MRC CLINIC(1992)

Months	BSE	Pos.	Pv	Pf	SPR	SfR	Pf%
Jan	25	-	-	-	-	-	-
Feb	27	-	-	-	-	-	-
Mar	43	3	3	-	7.0	-	-
Apr	63	4	4	-	6.3	-	-
May	53	4	4	-	7.5	-	-
Jun	70	11	11	-	15.7	-	-
Jul	96	9	9	-	9.4	-	-
Aug	153	30	29	1	19.6	0.7	3.3
Sep	221	34	29	5	15.4	2.3	15.0
Oct	119	20	17	3	16.8	2.5	15.0
Nov	41	3	2	1	7.3	2.4	33.3
Dec	25	3	3	-	12.0	-	-
Total	936	121	111	10	12.9	1.1	8.2

RELAPSE PATTERN IN P. VIVAX CASES:

Twelve months follow-up studies of established P. vivax cases were undertaken to know the relapse rate, relapse frequency and assessment of the anti-relaptic efficacy of primaquine when given as a 5 day radical course. In 1292 cases treated with chloroquine and primaquine for five days, the relapse rate was 14.0% as compared to 44.8% in 67 cases treated with chloroquine only (Table 9).

Occurrance of relapses were more in the first six months after primary infection, irrespective of whether treated with chloroquine or primaquine or with both. In both the groups high relapses were observed during 30-120 days and 240-365 days indicating short and long incubation period of relapsing stages of P. vivax strain. Agewise analysis revealed no age-specificity of relapse rate in both the cases, however the variation observed in cases treated with chloroquine only might be due to low number of primary cases in the age-group below 8 years. The results thus indicated that primaquine is effective in inhibiting the relapse upto an year after 5 day radical course in 68.8% cases.

MALARIA CLINIC REPORT:

A total of 936 blood smears from fever patients of Haldwani and nearby area were examined during January to December 1992. Among these, 121 cases were found positive of malaria showing SPR and SfR, 12.9 and 1.1, respectively. This reflects an increase in slide positivity rate than the previous year 1991 (SPR = 9.4, SfR = 0.9). Monthwise epidemiological data revealed that highest SPR (19.6%) and SfR (2.5%) was recorded in the month of August and October, 1992, respectively (Table 10).

MALARIA AND FILARIASIS SURVEY IN MIGRATORY POPULATION:

Surveys among migratory labour of eastern U.P. and Bihar residing in colonies of Livestock Research Centre, Crop Research Centre and Horticulture Research Centre, of G.B. Pant University of Agriculture and Technology, Pantnagar were carried out during the months of September to November, 1992, A total of 474 blood smears prepared during night (2000 to 2400 h) were stained and examined. The microfilaria rate (mf.) and malaria slide

TABLE 11: HALDWANI: EPIDEMIOLOGICAL SURVEY ON MALARIA AND FILARIA IN THREE COLONIES OF G.B. PANT UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR, NAINITAL

Locality/ colony	BSE	Microfilaria positive		Malaria positive				
		Total	Rate	Pv	Pf	Total	SPR	SfR
LRC	251	10	3.98	-	-	-	-	-
CRC	111	3	2.72	1	1	2	1.80	0.90
HRC	112	-	-	1	-	1	0.89	-
TOTAL	474	13	2.74	2	1	3	0.63	0.21

positivity rate (SPR) was 2.74 and 0.63, respectively. The results are shown in Table 11. Case history of patients revealed that 75% mf. cases were coming from Deoria district, U.P. and remaining 25% from the districts of Bihar.

(iii) SHANKARGARH, ALLAHABAD DISTRICT, U.P.

Shankargarh PHC of district Allahabad (U.P.) is known for its silica sand, stone quarries and high incidence of malaria. Local transmission is aggravated by constant labour movement from adjoining Banda district and neighbouring Madhya Pradesh state resulting in the introduction of different falciparum strains, some resistant to chloroquine. To counter this problem bio-environmental control strategy was launched in June 1987. From June 1987 to October 1992 various data on epidemiology, entomology and larval ecology were collected. From July 1992 onwards the study area was reduced to 5 experimental villages (population 3059) and 2 control villages (population 1274).

Source Reduction: During October 1991 to September 1992, 1,29,202 breeding sites were surveyed out of which, 81,833 breeding sites were found positive in experimental villages (positivity 63.3%). Mosquito breeding was eliminated from 74,933 positive sites whereas 65,996 breeding sites were filled up/levelled. In control, out of 24,729 breeding sites surveyed 17,843 were found positive (positivity 72.2%). In experimental villages 28 soakaway pits were constructed, margins of 2499 ditches and ponds were cleaned and repaired and waste water collection at 115 spots were canalized to maintain free water flow. A total of 30 tractor trolley loads of earth and stone was used for filling work in experimental villages. Progress of work at a glance is given in Table 1.

Biological Control: During October 1991 to September 1992 nearly 58707 larvivorous fishes were introduced in positive breeding sites. Presently, 8 hatcheries are being maintained as fish stocks with over 10 lakh larvivorous fishes. As a result of source reduction and biological control activities, the average per cent positivity of mosquito breeding always remained low in the experimental villages.

Health Education: With a view to inculcate awareness in public regarding bioenvironmental control strategy 21 health camps (participants 2239) and 689 group meetings (participants 5924) were arranged in experimental villages. A total of 10 shramdans were organized.

Parasitological Survey: A mobile field malaria clinic was established from February 1992 onwards with an objective to test maximum population of experimental villages. Smears were collected from fever and non-fever cases without giving

TABLE 1: SHANKARGARH: PROGRESS AT A GLANCE *

INTERVENTION/SOURCE REDUCTION		
Breeding sites surveyed	: 129202	(24729 in Control)
sites found positive	: 81833	(17843 in Control)
sites where breeding was eliminated	: 74933	
sites eliminated	: 65996	
margins repaired	: 2499	
canalization	: 115	
soakaway pits made	: 28	
trolley loads used for filling	: 30	
BIOLOGICAL CONTROL		
hatcheries maintained	: 8	
fishes in hatcheries (estimate)	:1025000	
fishes introduced in breeding sites	: 58707	
CHEMOTHERAPY		
presumptive treatment	: 12179	
radical treatment	: 14858	
HEALTH EDUCATION		
health camps organized	: 21	
participants in health camps	: 2239	
group meetings done	: 689	
participants in group meetings	: 5924	
COMMUNITY PARTICIPATION		
shramdans organized	: 10	
participants in shramdans	: 143	
ENVIRONMENTAL IMPROVEMENT		
trees planted	: 79247	
solar cooker demonstration done	: 1	

* From October 1991 to September 1992

presumptive treatment. Slides were examined in the field itself and positive cases were administered radical treatment by MRC staff on the spot. Monthwise data is presented in Table 2.

TABLE 2: SHANKARGARH: MALARIA SITUATION IN STUDY VILLAGES

Month		Population	No. of villages	BSC/E	TPC	+ve for			SPR	SfR
						Pv	Pf	Mix		
1991										
Oct	E	16302	36	4975	2802	293	2500	9	56.3	50.4
	C	1973	4	281	159	39	119	1	56.6	42.7
Nov	E	16302	36	2338	1296	53	1242	1	55.4	53.2
	C	1973	4	137	83	5	78	-	60.6	56.9
Dec	E	16302	36	670	408	12	395	1	60.9	59.1
	C	1973	4	120	71	4	67	-	59.2	55.8
1992										
Jan	E	6908	16	441	218	5	213	-	49.4	48.3
	C	3170	4	118	48	1	47	-	40.7	39.8
Feb	E	6908	16	515	100	7	93	-	19.4	18.1
	C	3170	4	98	24	2	22	-	24.5	22.4
Mar	E	6908	16	1146	152	45	107	-	13.3	09.3
	C	3170	4	114	20	6	14	-	17.5	12.3
Apr	E	6908	16	460	97	75	21	1	21.1	04.9
	C	3170	4	144	42	36	6	-	29.2	04.2
May	E	6908	16	501	147	138	9	-	29.3	01.8
	C	3170	4	173	54	52	2	-	31.2	01.2
Jun	E	6908	16	423	90	89	1	-	21.3	00.2
	C	3170	4	129	40	38	2	-	31.0	01.6
Jul	E	3059	5	362	50	46	4	-	13.8	01.1
	C	1274	2	71	24	24	0	-	33.8	00.0
Aug	E	3059	5	662	152	72	80	-	23.0	12.1
	C	1274	2	90	23	16	7	-	25.6	07.8
Sep	E	3059	5	962	239	71	168	-	24.8	17.5
	C	1274	2	67	17	10	7	-	25.4	10.4
Total	E			13455	5751	906	4833	12	42.7	36.0
	C			1541	605	233	37[1]	1	39.2	24.1

* From October 1991 to September 1992

Malaria Clinic: A malaria clinic is in operation. A large number of patients turn up, thus increasing the work load considerably. A total of 18,062 smears were collected during October 1991 to September 1992, out of which 9367 cases were found malaria positive. The SPR was 51.9 with 63.2% Pf cases. Monthwise epidemiological data is presented in Table 3.

CHLOROQUINE SENSITIVITY IN P. FALCIPARUM IN VIVO:

An extended in vivo study was conducted during the winter season from November 1992 to January 1993, for evaluating sensitivity to chloroquine using standard WHO method. From malaria clinic, 78 patients, showing different degrees of parasitaemia were selected for study. Standard regimen of 25mg chloroquine per kg body weight over a period of three days (10mg/kg, 10mg/kg and 5 mg/kg) respectively were administered. Blood smears were collected on day0, day2, day7, day14, day21 and day28. Out of 78 cases 48 asexual parasitaemia disappeared completely within seven days and did not re-appear for the

TABLE 3: SHANKARGARH: MALARIA CLINIC DATA *

Month	BSC/E	TPC	+ve for			SPR	SfR
			Pv	Pf	Mix		
1991							
Oct	2791	1795	447	1340	8	64.3	48.3
Nov	1879	1354	107	1247	-	72.1	66.4
Dec	1988	1394	91	1299	4	70.1	65.5
1992							
Jan	1339	789	53	736	-	58.9	55.0
Feb	889	360	27	333	-	40.5	37.4
Mar	571	177	67	110	-	31.0	19.3
Apr	438	154	100	54	-	35.2	12.3
May	608	269	248	21	-	44.2	03.5
Jun	889	453	438	15	-	51.0	01.0
Jul	1404	605	600	5	-	43.1	00.4
Aug	1823	637	524	113	-	34.9	06.2
Sep	3443	1380	746	634	-	40.0	18.4
Total	18062	9367	3448	5907	12	51.9	32.8

* From October 1991 to December 1992

TABLE 4: SHANKARGARH: RESULTS OF WHO IN-VIVO 28 DAY EXTENDED TEST

S.No.	Age	Sex	Asexual parasite count/cu mm blood at different days interval						Degree of Resistance
			D-0	D-2	D-7	D-14	D-21	D-28	
1.	10	F	7750	Pfg	Neg	Pfg	Neg	Neg	S
2.	14	M	6250	Neg	Pfg	Pfg	250	-	R I
3.	30	F	750	Neg	Pfg	500	-	-	R I
4.	13	M	19750	Neg	Pfg	Pfg	Pfg	Neg	S
5.	15	M	33750	Neg	Neg	Neg	Neg	Neg	S
6.	12	M	5250	PfR	Pfg	Pfg	2800	-	R I
7.	5	F	4500	Neg	Pfg	Neg	Neg	17500	R I
8.	18	M	1750	250	Pfg	Neg	Neg	Neg	S
9.	8	M	2875	1500	Pfg	Neg	Neg	Neg	S
10.	7	F	1250	Neg	Neg	Neg	Neg	Neg	S
11.	27	F	36500	1750	Pfg	Pfg	Pfg	Neg	S
12.	5	F	30000	Pfg	Pfg	Pfg	13500	-	R I
13.	12	F	69000	Neg	Neg	Neg	Neg	Neg	S
14.	18	M	1750	Pfg	Pfg	21500	-	-	R I
15.	10	F	5250	Neg	Pfg	Pfg	Neg	Neg	S
16.	7	F	5250	Neg	Pfg	Pfg	10500	-	R I
17.	6	M	500	Neg	Neg	Neg	NA	500	R I
18.	7	F	2250	Neg	Pfg	Pfg	Neg	NA	S
19.	55	F	1000	Neg	Neg	Pfg	3250	-	R I
20.	5	F	1250	Pfg	Pfg	Neg	Neg	Neg	S
21.	40	M	9000	250	Neg	Neg	Neg	Neg	S
22.	12	M	2250	Neg	Pfg	Pfg	9000	-	R I
23.	12	M	1250	PfR	Pfg	Pfg	7750	-	R I
24.	14	M	8000	Neg	Pfg	Neg	Neg	Pfg	S
25.	22	M	3500	Neg	Pfg	Neg	Neg	Neg	S
26.	48	M	25500	1750	Pfg	Pfg	2000	-	R I
27.	8	F	42500	PfRG	Pfg	Neg	Pfg	Neg	S
28.	12	M	11000	Pfg	Pfg	Neg	Neg	Neg	S
29.	35	F	9000	Neg	Neg	Neg	Neg	Neg	S
30.	19	M	7000	Neg	Neg	Neg	Neg	Neg	S
31.	10	M	28000	NA	Pfg	Neg	9500	-	R I
32.	10	M	7500	Pfg	Neg	Pfg	79000	-	R I
33.	30	F	20000	PfRG	Pfg	Pfg	11500	-	R I
34.	18	F	20500	Neg	Neg	Neg	Neg	Neg	S
35.	15	M	13000	Neg	Neg	Neg	Neg	Neg	S
36.	10	F	18500	Neg	Neg	Neg	Neg	Neg	S
37.	50	F	13000	Neg	Neg	Neg	Neg	Neg	S
38.	40	M	8000	PfR	Neg	500	-	-	R I
39.	15	M	80000	Neg	Neg	Pfg	4500	-	R I
40.	18	M	86000	Neg	Pfg	Pfg	34500	-	R I
41.	10	M	32000	Neg	Pfg	78000	-	-	R I
42.	5	M	5000	Pfg	Neg	Neg	8000	-	R I
43.	30	M	21600	7750	Pfg	Pfg	84000	-	R I

Contd....

TABLE 4: SHANKARGARH: RESULTS OF WHO IN-VIVO 28 DAY EXTENDED TEST (Contd..)

S.No.	Age	Sex	Asexual parasite count/Cu mm blood at different days interval						Degree of Resistance
			D-0	D-2	D-7	D-14	D-21	D-28	
44.	30	M	21600	Neg	Pfg	7700	-	-	R I
45.	7	M	3400	Pfg	Pfg	Pfg	NA	NA	S
46.	10	F	3600	NA	Neg	Neg	Neg	Neg	S
47.	28	M	12000	Neg	Neg	Neg	Neg	Neg	S
48.	40	M	10000	600	Pfg	Neg	Neg	Neg	S
49.	30	F	27000	Neg	Neg	Neg	Neg	Neg	S
50.	25	F	13600	Neg	Neg	Neg	Neg	Neg	S
51.	18	M	8500	Neg	Neg	Neg	Pfg	Neg	S
52.	3	M	15125	750	1600	-	-	-	R II
53.	25	M	7750	Neg	Neg	Neg	28500	-	R I
54.	20	F	11500	Neg	Neg	Neg	Neg	Neg	S
55.	7	M	15250	Pfg	Pfg	Pfg	Neg	Neg	S
56.	7	M	5000	Pfg	Pfg	Pfg	293750	-	R I
57.	4	M	8500	PfRG	Pfg	Neg	14000	-	R I
58.	7	F	12000	Pfg	Pfg	NA	Pfg	Neg	S
59.	20	F	120500	Neg	Pfg	Pfg	Pfg	Neg	S
60.	10	M	3000	Neg	Neg	Neg	Neg	Neg	S
61.	8	F	6000	Neg	Pfg	Pfg	Neg	Neg	S
62.	11	F	48000	Neg	Pfg	Pfg	Neg	Neg	S
63.	7	M	13000	Neg	Neg	Neg	10000	-	R I
64.	35	M	4250	PfR	Neg	Neg	Neg	Neg	S
65.	4	F	99000	Pfg	Pfg	NA	Neg	Neg	S
66.	35	F	9500	Neg	Neg	Neg	Neg	Neg	S
67.	20	M	5500	Pfg	Pfg	Neg	Neg	Neg	S
68.	7	F	2750	Pfg	Neg	Neg	Neg	Neg	S
69.	4	M	2500	Pfg	Neg	Pfg	58250	-	R I
70.	13	F	3500	Neg	Pfg	Pfg	500	-	R I
71.	24	M	26600	Neg	Neg	Pfg	Pfg	Neg	S
72.	25	M	3000	Neg	Neg	Neg	7000	-	R I
73.	6	M	4600	Neg	Neg	Neg	NA	Neg	S
74.	7	F	1200	Pfg	Pfg	NA	600	NA	S
75.	6	M	1200	Neg	Neg	Neg	Neg	Neg	S
76.	10	M	29000	Neg	Pfg	Neg	Neg	Neg	S
77.	35	M	3400	PfRG	Pfg	Pfg	Pfg	Pfg	S
78.	35	M	4000	Neg	NA	Neg	Neg	NA	S

NA = Not available; Neg = Negative; Pfg = P. falciparum gametocyte;
PfR = P. falciparum ring; PfRG = P. falciparum ring gametocyte

No. of cases	'S'	R I	R II	R III
78	48	29	1	Nil

remaining period, thus showing sensitivity (s) (61.5%). In 29 cases, parasitaemia re-appeared within 28 days and were graded as resistant at R I level (37.2%), while in one case marked reduction in parasitaemia was observed but it did not disappear completely and hence it was graded as resistant at RII level (1.3%). No case of RIII resistance level was observed (Table 4).

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During this period following research activities were carried out for the control of malaria and other vector borne diseases.

PRELIMINARY EFFICACY OF BIOCIDES AGAINST ANOPHELINES AND CULICINE MOSQUITOES

Due to the development of insecticide resistance in mosquitoes as well as their health hazards there is an urgent need to find out an alternative to insecticides for the control of mosquitoes and vector borne diseases. In this regard biocides are promising one. However, studies related to their large scale trials for control of mosquito larvae under field conditions are lacking. Therefore, Bacillus thuringiensis (Bactoculicide) and Bacillus sphaericus (Spherix) were applied in separate pools. For this 5 gm biocide powder was mixed with one litre water to get a 0.5% suspension. Surface area of each experimental pool was measured. The suspension was applied by spray pump over the breeding site upto one metre distance from the margins.

Larval densities (per dip) of I and II, III and IV instars and pupae of both anopheles and culex spp. were recorded in the untreated and treated habitats before treatment (0 day) and on 1,2,3,7,10,14,18 and 21 day of its application. Further, monitoring was carried out weekly upto 8 weeks (56 days) for anopheline and 49 days (7 weeks) for culicine larvae. Per cent reduction in III and IV instar larval density was calculated using the formula described by Mulla (1971). Results obtained with Bactoculicide and Spherix are depicted in Figures 1 and 2 respectively.

Bactoculicide: After Ist day of Bactoculicide application reduction of 98.1 and 87.3 per cent in larval densities of anopheles and culex spp. respectively were observed. Further reduction in larval densities occurred on day 2. On day 3 impact was found equal on the larvae of both anopheline and culicine. Results obtained on day 7 and subsequent period (56 days) of the study provided more than 37% control of anopheline and 53.5% in culicine larvae (Fig.1).

Spherix: Spherix produced 82.0 and 28.9 per cent reduction in larvae of anopheline and culicine spp. respectively within 24 hours of its application. Reduction in larval densities of both anophelines and culicines on day 2 were same as on day 1. However, 97.1% control of anophelines and 98.5% control of culicine larvae was recorded on 3rd post application day (Fig. 2).

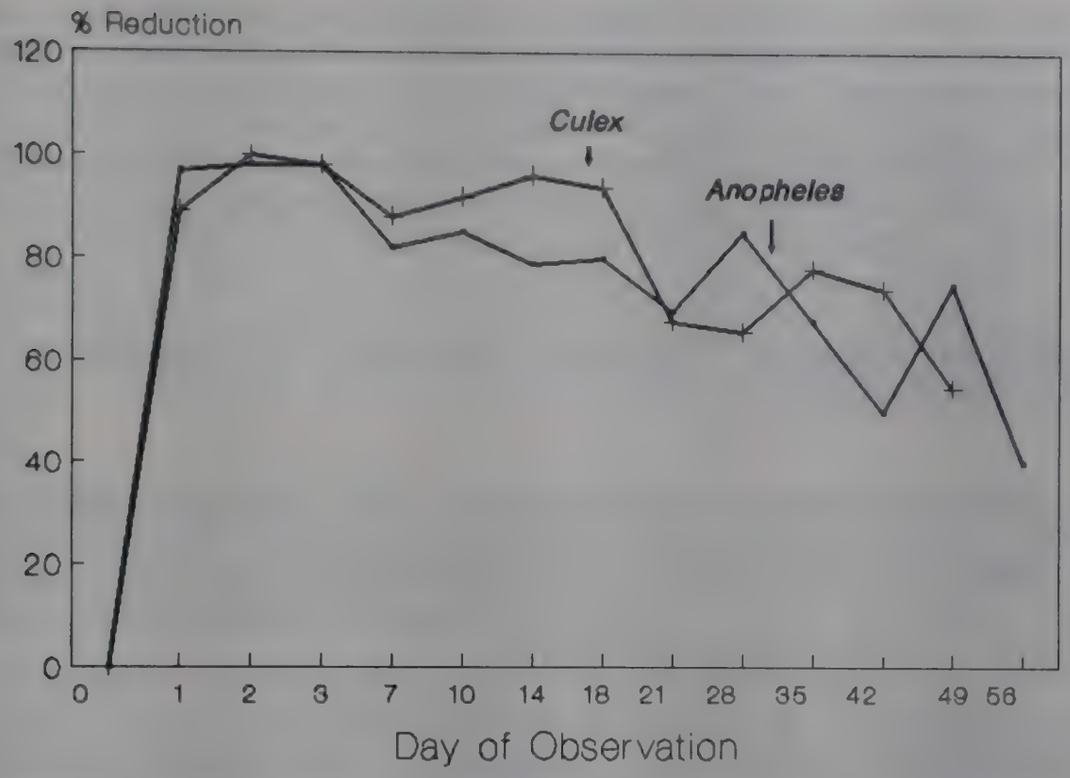


Fig. 1: Shahjahanpur: Impact of Bactoculicide (B. thuringiensis) on larvae of Anopheles and Culex spp.

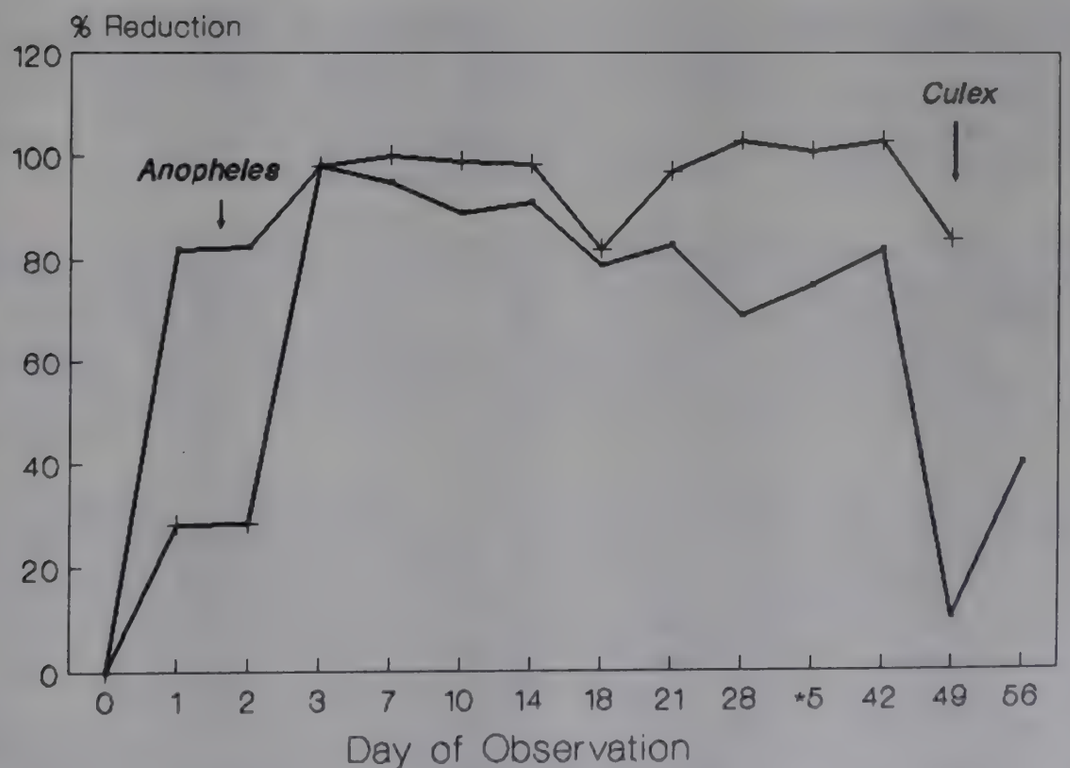


Fig. 2: Shahjahanpur: Impact of Spherix (B. sphaericus) on larvae of Anopheles and Culex spp.

Overall results of field evaluation of these biocides revealed that Bactoculicide in comparison to Spherix produced higher mortality of both anopheline and culicine larvae on day 1 and 2nd post application day. After 7th day of treatment impact of these biocides was more or less similar on anopheline but on culicine larvae Spherix had slightly more impact as compared to Bactoculicide. Species specific trials are now under way.

STUDIES ON THE OUTBREAK OF MALARIA EPIDEMIC IN BANIYANI VILLAGE OF DISTRICT FARRUKHABAD.

Many fever deaths were reported in village Baniyani of Talgram PHC of District Farrukhabad during August 1991 to November 1991 which is malaria transmission period. Detailed study was carried out in this PHC from 20 October 1991 to December 1991 on different occasions.

Malaria Prevalence: Records of malaria cases of last five years were not available in the PHC. However, the malaria record of 1991 from the PHC was available. The monthly collection of blood smears by PHC surveillance workers from Baniyani village during Jan to Dec, 1991 has been given in Table 1. There was continuous increase in the collection of slide in subsequent months indicating thereby an increase in the fever cases (20 in the

TABLE 1: SHAHJAHANPUR: BLOOD SMEAR COLLECTIONS BY NMEP WORKER FROM BANIYANI VILLAGE DURING JAN TO DEC. 1991

Month	B.S.C.	Positive for malaria			Total	Deaths
		Pv	Pf	Mixed		
Jan	8	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	0	0	0	0	0	0
Apr	20	0	0	0	0	0
May	25	0	0	0	0	0
Jun	21	0	0	0	0	0
Jul	37	0	0	0	0	0
Aug	53	0	0	0	0	5
Sep	76*	0*	0*	0*	0*	8
Oct	2134	197	128	0	325	10
Nov	585	409	78	1	128	8
Dec	275	4	31	0	35	0

* 38 slides were cross-examined, 16 were positive for P. falciparum (SfR = 42.10), 2 were positive for P. vivax (Svr = 5.26) SPR = 47.37, Population = 1295

month of Apr and 76 in Sept). A total number of 240 blood smears were collected during Jan to Sept, 1991 but none was found positive for malaria parasite (PHC record), whereas in the month of Oct, 1991 there was drastic increase in the collection of blood smears (2134) and malaria positive cases (Total 325, P. vivax 197 and P. falciparum 128).

Monthwise occurrence of deaths in this village has been given in Table-1. As per the PHC record first death was reported from this village in the month of July. There were five deaths in August followed by 8 in September, 10 in October and 8 in November.

Control operation by NMEP: Over the previous ten years or so no antimosquito measures were undertaken in Baniyani. However, following the recent epidemic, one-round spraying of DDT was done on 10 and 11 October, 91.

According to the record of the Health Inspector, HCH was also sprayed on these dates. Six rounds of fogging with 5% malathion were also done. Antilarval measures were undertaken by applying six rounds of Baytex in the ponds and other water collections in the village.

Entomological survey: There are 12 small ponds in the village (None in agriculture field) 33 wells (31 in village, 2 in field) and one minor drain around the village). None of the 10 ponds and 7 wells checked for mosquito breeding were found positive for mosquito larvae. However, mosquito breeding was encountered in the water collection in rice field and tube well tanks near the village. The respective density of mosquito larvae was 78 and 241 per 5 dips in rice field and tube well tanks (Table-2).

Three anopheline species An. culicifacies, An. annularies An. subpictus were found in the village. An. culicifacies seems to be the malaria vector. The man hour density (MHD) of An. culicifacies was found to be 2 (Table-3). Therefore, it appeared that intervention measures were effective in breaking down the transmission.

Parasitological findings: A total number of 190 slides were collected on different dates during the months of Nov-Dec 1991. Out of which 98 were positive for P. falciparum. None was positive for P. vivax. A survey of children in 2-9 years age group of local Primary School showed very high spleen rate (82.9%). The average enlarged spleen rate was 1.9. The child parasite rate was also very high (40.0 SfR). Blood smears of only three infants could be collected of which two were positive for P. falciparum (Table-4).

TABLE 2: SHAHJAHANPUR: LARVAL POSITIVITY OF MOSQUITO BREEDING SITES

Type of breeding site	No. of breeding sites checked	Breeding sites found + ve	Larval density/5dips	
			Culex	Anopheles
Pond	10	0*	0	0
Waste water street	4	0*	0	0
Small ditch	2	0*	0	0
Rice field	2	1	0	78
Waste water (Tube well)	2	2	10	241
Well	7	0	0	0

* Six rounds of Baytex applications was done by Health Deptt. Harvested rice fields with patchy collection of water from tube wells

TABLE 3: SHAHJAHANPUR: MOSQUITO DENSITY IN BANIYANI

S.No.	Species	MHD
1.	An. culicifacies	2
2.	An. annularies	11
3.	An. subpictus	3
4.	Culex	16

Note : In spite of spraying of one round each of DDT and HCH, six rounds of malathion fogging and six rounds of application of Baytex in ponds/drains, etc.

SURVEY OF MALARIA IN DISTRICT FARRUKHABAD (U.P.)

A random fever survey was carried out from Nov 1991 to Sept 1992 in District Farrukhabad (U.P.) for the detection of malaria. This survey was carried out in 37 villages of PHC's of this district covering a population of 44,453 during the above mentioned period. A total of 1195 peripheral smears were prepared from the fever cases. Out of which 429 (35.89%) were positive for malaria. P. falciparum and P. vivax were detected in 236

TABLE 4: SHAHJAHANPUR: SLIDE POSITIVITY FOR MALARIA IN BANIYANI

Date of MRC Survey	Age group	B.S.C.	Cases positive		SPR	Pf%
			Pv	Pf		
20.11.91	All ages	27	0	21	77.8	100
26.11.91	All ages	45	0	18	40.0	100
03.12.91	All ages	34	0	20	58.8	100
04.12.91	Children 2-9 years	52	0	20	38.5	100
19.12.91	All ages	14	0	11	78.5	100
19.12.91	Children	18	0	8	44.4	100
	Total :	190	0	98	57.57	100

(55.02%) and 193 (44.89%) cases respectively. Overall the slide positivity rate and slide falciparum rates were 35.89 & 19.74 respectively. Month and villagewise results have been summarised in Table 5. The survey is under progress.

DETECTION OF CHLOROQUINE RESISTANCE IN P. FALCIPARUM CASES IN DISTRICT FARRUKHABAD

One of the major setback to malaria control programmes is the occurrence of chloroquine resistant Plasmodium falciparum strains. ' For better management of chloroquine resistance there is an urgent need to monitor the drug resistance in P. falciparum cases.

To detect chloroquine resistance both in-vivo and in-vitro methods have been tried. Various in-vivo methods presently in use are time consuming that require daily follow-up and patients have to wait till 7 days before the alternate treatment is started. To overcome these problems simplified in-vivo test system has been intrduced by us. In this procedure only two follow-up blood examinations are required and infection can be declared resistant within 2nd day of drug administration. This study had been carried out using small number of patients (47

TABLE 5: SHAHJAHANPUR: MONTHWISE AND VILLAGEWISE RANDOM FEVER SURVEY CARRIED OUT IN EIGHT DIFFERENT PHC'S OF DISTRICT FARRUKHABAD (FROM NOV 1991 TO SEPT 1992) FOR THE DETECTION OF MALARIA

Month/ and year of Survey	Name of P.H.C.	Name of the Village	Popln.	B.S.C	Pv	Pf	Total	SPR	SfR
November (1991)	Talgram	*Baniyani	3403	72	0	39	39	54.16	54.16
"	"	Majhpurwa	4000	15	3	5	8	53.30	33.30
"	"	*Yadav Nagar	350	5	1	0	1	20.00	20.00
"	"	Pal Nagar	350	36	3	22	25	69.44	61.11
"	"	Uncha	3000	6	3	1	4	66.70	16.70
"	"	*Kudri Purwa	300	6	0	2	2	33.30	33.30
"	"	*Gyanpur	500	16	0	12	12	75.00	75.00
December (1991)	Talgram	*Baniyani	3403	***104	0	48	48	46.15	46.15
"	"	Gyanpur	500	**58	1	4	5	8.60	6.90
"	Jallalabad	Pachpokhara	450	5	2	1	3	60.00	20.00
"	"	Pachhaha Purwa	500	9	1	3	4	44.44	33.33
"	"	Khera	300	3	1	0	1	33.30	00.00
"	"	Gaderian Purwa	250	3	1	1	2	66.66	33.33
"	"	*Jamala	350	48	2	22	24	50.00	45.83
"	"	Alam Nagar	600	3	0	0	0	00.00	00.00
"	"	Gouriapur	2000	9	0	5	5	55.60	55.60
January (1992)	Talgram	Baniyani	3403	7	0	5	5	71.40	71.40
"	"	Tera Rabbu	2000	4	0	1	1	25.00	25.00
"	"	Pal Nagar	350	5	0	0	0	00.00	00.00
"	"	Majhpurwa	4000	6	0	2	2	33.33	33.33
"	"	*Nangapurwa	1000	20	0	0	0	00.00	00.00
"	"	*Dhamiapur	3000	39	0	8	8	20.51	20.51
"	Jallalabad	Bahelinpurwa	350	5	0	1	1	20.00	20.00
"	"	Nekpur	500	0	0	0	0	00.00	00.00
"	"	Jamala	350	4	0	4	4	100.00	100.00
"	"	Gouriapur	2000	61	0	13	13	21.31	21.31
February (1992)	Jallalabad	Gouriapur	2000	64	0	7	7	10.93	10.93
"	"	Mirgawan	6000	58	0	0	0	00.00	00.00
"	"	Bahelianpurwa	350	43	1	0	1	2.32	00.00
"	"	Tikaiyapurwa	200	4	1	0	1	25.00	00.00
"	Kannauj	Daipur	2500	4	0	0	0	00.00	00.00
"	"	Panwara	1000	5	0	0	0	00.00	00.00
"	"	Shareejapur	2000	1	0	0	0	00.00	00.00
"	"	Devaputti	300	0	0	0	0	00.00	00.00
"	"	Mudeferpur	350	0	0	0	0	00.00	00.00
"	"	Yaseempur	500	0	0	0	0	00.00	00.00

Contd....

TABLE 5: SHAHJAHANPUR: MONTHWISE AND VILLAGEWISE RANDOM FEVER SURVEY CARRIED OUT IN EIGHT DIFFERENT PHC'S OF DISTRICT FARRUKHABAD (FROM NOV 1991 TO SEPT 1992) FOR THE DETECTION OF MALARIA (Contd.)

Month/ and year of Survey	Name of P.H.C.	Name of the Village	Popln.	B.S.C	Pv	Pf	Total	SPR	SfR
May (1992)	Talgram	Talgram	3403	38	19	2	21	55.30	5.26
"	"	Pal Nagar	350	13	9	0	9	69.20	00.00
"	Jallalabad	Gouriapur	2000	12	2	0	2	16.70	00.00
"	"	Jamala	350	16	4	7	11	68.75	43.75
"	"	Pachhahpurwa	500	2	1	0	1	50.00	00.00
June (1992)	Talgram	Baniyani	3403	38	19	2	21	55.26	5.30
"	"	Pal Nagar	350	13	9	0	9	36.23	00.00
"	"	Yadav Nagar	350	10	6	0	6	60.00	00.00
"	Jallalabad	Gouriapur	2000	4	3	0	3	75.00	00.00
"	"	Jamala	350	23	5	10	15	65.21	43.47
"	"	Bahelianpurwa	350	8	4	0	4	50.00	00.00
August (1992)	Talgram	*Baniyani	3403	49	30	1	31	63.26	26.04
"	"	Pal Nagar	350	2	0	0	0	00.00	00.00
"	"	Yadav Nagar	350	5	0	1	1	20.00	20.00
"	"	Gudarianpurwa	300	14	4	1	5	35.71	7.14
"	Jallalabad	Behelianpurwa	350	25	9	0	9	36.00	00.00
"	"	Jamala	350	14	2	4	6	42.90	28.60
"	"	Gauriapur	2000	16	7	1	8	50.00	6.30
"	"	Tikaiyapurwa	200	23	7	2	7	30.40	00.00
"	"	Gadarianpurwa	250	10	7	2	9	90.00	20.00
September (1992)	Talgram	Baniyani	3403	53	23	1	24	45.30	1.90
"	Chibramau	Pooran Nagar	250	10	1	0	1	10.00	00.00
"	Saurikh	Chandra	500	16	3	1	4	25.00	6.25
"	"	Salempur	2200	30	22	0	22	73.30	00.00
"	Baron	Pach Pokhar	500	7	0	0	0	00.00	00.00
"	"	Gulalanagr	300	6	0	0	0	00.00	00.00
"	Rajepur	Mahadpur	1000	11	0	0	0	00.00	00.00
"	"	Kuriyan	700	5	0	0	0	00.00	00.00
"	"	Madaiya	150	2	0	0	0	00.00	00.00
"	Kamalganj	Shekhpur	5000	5	0	0	0	00.00	00.00
"	"	Bhojpur	2000	21	0	0	0	00.00	00.00
			44453	1195	193	236	429	35.89	19.74

only). To vaildate the method it should be tested on large number of patients in field. Therefore, a study using simplified in-vivo test system was carried out to detect chloroquine resistance in P. falciparum. For comparison sake 7 day in-vivo method and 28 day in-vivo extended test as recommended by WHO were also applied.

Selection of patients for detection of chloroquine resistance: Out of all the P. falciparum positive cases only 78 were found fit for carrying out chloroquine resistance studies i.e. they were harbouring ring stage of the parasite, and had sufficient parasitaemia. Their urine was found negative for chloroquine as checked by Dill and Glazko's method. Chloroquine resistance was detected through (i) Simplified in-vivo method and (ii) WHO in-vivo extended test methods.

Results of three day in-vivo test system: For the detection of chloroquine resistance /sensitivity, 78 cases of P. falciparum were selected. Out of them only 48 cases were available for the follow-up.

Out of 48 cases, 14 were found resistant to chloroquine. In 14.2 per cent (7 cases) RIII degree resistance was observed. S/RI late degree of resistance was found in 6 cases. RI early/RII RI early/RII was detected only in one patient (2.08%). Table-6 shows the different degree of resistance detected in these patients.

TABLE 6: SHAHJAHANPUR: DIFFERENT DEGREES OF CHLOROQUINE RESPONSES DETECTED IN PLASMODIUM FALCIPARUM FROM DISTRICTS FARRUKHABAD (U.P.) USING SIMPLIFIED IN-VIVO METHOD

Response	Total No. of Patients (N = 48)	Percentage
S/RI (very good response)	34	70.8
S/RI late (good response)	6	12.5
RI early/RII (partial response)	1	2.08
RIII (poor response)	7	14.58

All these chloroquine resistant cases were treated with 1500 mg of metakelfin.

Results of WHO in-vivo extended test methods: In all the above mentioned falciparum cases, resistance was also detected using WHO in-vivo extended test to differentiate between resistant and susceptible cases. Out of above 48 cases there were 38 cases who could be followed upto 28 days,

In these patients smears were also prepared on days 14,21 and 28. On the basis of these tests those who were also negative till day 28 were identified as susceptable. According to WHO in vivo extended test out of these 32 cases 14 (36.84%) cases were susceptible to chloroquine and 18 (47.36) showed RI late degree response (Table-7).

Results on the basis of WHO 7 day in-vivo test: When results of these 48 cases were analysed on the basis of WHO 7 day in-vivo test the number of patients with RIII and RII degree of resistance were similar to that of simplified in-vivo method these were 5 RIII (13.15%) and one RII (2.63%) degree resistant cases and 32 (84.21%) were graded as S/RI (Table-8).

Comparison of results of the simplified in-vivo test system with that of WHO 7 day in-vivo test system and WHO extended test system: Tables 6 and 7 shows the results obtained through different in-vivo test system. The results of 7 day and simplified test system were comparable in the detection of RIII and RII level resistance. Not only this the percentage of S/RI degree cases was also similar with both three day (83.33%) and 7 day (84.21%) in-vivo methods (Table 8). When these cases were

TABLE 7: SHAHJAHANPUR: DIFFERENT DEGREES OF DRUG RESPONSE DETECTED IN P. FALCIPARUM DISTRICT FARRUKHABAD (U.P.) USING WHO IN-VIVO EXTENDED TEST SYSTEM

Type of response	Total number of patients (N = 38)	Percentage
Sensitive	14	36.84
RI late	18	47.36
RI early	0	0.00
RII	1	2.63
RIII	7	13.15

TABLE 8: SHAHJAHANPUR: COMPARISON OF OVERALL SUSCEPTIBILITY AND RESISTANCE LEVEL OF PLASMODIUM FALCIPARUM STRAINS DETECTED BY SIMPLIFIED AND SEVEN DAY IN-VIVO TEST SYSTEMS

Type of response	In-vivo methods applied	
	Simplified test (N=48)	WHO 7 day test (N=38)
	*	**
S/RI	40 (83.33)	32 (84.21)
RII	1 (2.08)	1 (2.63)
RIII	7 (14.58)	7 (13.15)

* S/RI + S/RI late cases
** S+R late cases

followed up till day 28, difference between sensitive and resistant strains could be identified. Out of 32 cases of S/RI degree, 24 were found sensitive to chloroquine as none of these were found positive till day 28.

STATUS OF CHLOROQUINE RESISTANCE IN DISTRICT FARRUKHABAD (U.P.)

Table-9 shows the overall picture of chloroquine sensitivity in District Farrukhabad (U.P.). Out of total cases studied there were 24 (63.15%) resistant and 14 (36.84%) sensitive to 1500 mg of chloroquine. Among the resistant cases 5 (13.15%) were of RIII degree.

TABLE 9: SHAHJAHANPUR: OVERALL STATUS OF CHLOROQUINE RESISTANCE IN DISTRICT FARRUKHABAD (U.P.)

Type of response	Number of cases (N = 38)	Percentage
Sensitive	14	36.84
Resistant	24	63.15

FILARIA SURVEY IN RURAL AREAS OF DISTRICT SHAHJAHANPUR

While carrying out malaria survey in the villages of the district Shahjahanpur concomitant infections of malaria and filariasis were encountered. Since there was no report regarding the occurrence of filariasis in rural area of the district a night filarial survey was carried out in 18 villages of District Shahjahanpur. Details of results obtained have been summarised in the Table-10. Out of 2141 people surveyed randomly, 217 were found positive for microfilarias of W. bancrofti. The microfilaria rate was 10.1%. It was slightly higher (10.2%) among men than women (09.9%). Statistically the differences were not significant ($p < 05$). The highest incidence (14.1%) was detected from Powayan PHC followed by Sindhauli (11.1%) and Bhawal Khera (9.3%). There were 245 cases showing one or the other symptom. Detailed clinical profile of these cases have been given in Table 11. Out of them only 60 cases (24.4%) were positive for microfilaria and rest (185) were negative. The most common manifestation was hydrocele (53.5%).

The manifestation of filarial diseases rate and the filarial endemicity rate were 11.4% and 18.8% respectively. Since most of the patients feel shy in showing their affected parts, these figures must be higher than what was observed. Manifestation rate was 13.0% among males and 8.0% among females. Similarly the filarial endemicity rate was also higher among males (20.8%) than females (15.3%). The difference was statistically significant ($P < 0.05$).

Among microfilaria carriers there were 8 children of less than 10 years of age. The youngest was a 4 years old girl however, the youngest persons having manifestations (hydrocele) were two boys of 10 years and 12 years of age.

A preliminary entomological survey of some of these villages showed existance of vector mosquitoes i.e. Culex quinquefasciatus. The average man hour density was 25.8

. The present study highlights the problem of filariasis in the rural areas of District Shahjahanpur. To the best of our knowledge their was no such report from this district. Although a filariasis control unit is working in this district since, 1986, but they are looking after only the urban population.

The microfilaria rate, disease rate and filarial endemicity rate of rural areas were higher than that of urbar areas as per the report of local filariasis unit (Table-12). Thus this study has shown that filariasis is endemic in the rural areas of District Shahjahanpur.

TABLE 10: SHAHJAHANPUR: RESULTS OF FILARIASIS SURVEY SHOWING MICROFILARIA RATE, DISEASE RATE AND FILARIA ENDEMICITY RATE IN RURAL AREAS

S.No.	Name of the PHC	Blood slide collected			Microfilaria positive			Micro-fila-ria rate	Manifestation			Disease rate	Filarial endemicity rate
		Male	Female	Total	Male	Female	Total		Male	Female	Total		
1.	Powayan	362	220	582	46	36	82	14.1	67	28	95	16.3	24.2
2.	Sindhauli	309	134	443	33	46	79	11.1	39	9	48	10.8	19.9
3.	Bhawal Khera	397	127	524	40	9	49	9.3	59	8	67	12.8	20.2
4.	Tilhar	200	102	302	14	4	18	6.0	14	5	19	6.3	11.3
5.	Kant	199	91	290	17	2	19	6.0	12	4	16	5.5	11.4
	Total	1467	676	2141	150	97	247	10.1	191	54	245	11.4	18.8

TABLE 11 : SHAHJAHANPUR: CLINICAL PROFILE OF THE CASES SURVEYED FOR FILARIASIS

S.No.	Type of Symptom	No. of Cases* (N = 245)	Percentage (%)
1.	Fever	45[a]	20.0
2.	Body Pain	10[b]	7.3
3.	Lymphangitis	8	3.3
4.	Lymphadenitis	2	0.8
5.	Lymphoedema	39	15.9
6.	Epididymo-orchitis	1	0.4
7.	Haematuria	11	0.4
8.	Hydrocele	131	53.5
9.	Chyluria	1	0.4
10.	Elephantiasis	2	0.8

N = Total number of cases with manifestations
* = There were 7 cases who had more than one symptom
a = 16 were positive for microfilariae
b = 6 were positive for microfilariae

TABLE 12: SHAHJAHANPUR: MICROFILARIA RATE, DISEASE RATE AND FILARIAL ENDEMICITY RATE OF URBAN AREA DETECTED BY FILARIA CONTROL RATE

Study year	Microfilaria rate		Disease rate		Filarial endemicity rate
	Male	Female	Male	Female	
1987	7.84	6.67	2.87	0.82	ND
1988	8.88	6.23	2.69	1.01	ND
1989	6.42	3.47	2.74	1.05	ND
1990	2.56*	-	3.14*	-	5.70*
1991	2.03	0.95	3.05	3.42	ND

* Both male and female
Source : Filariasis Control Unit, Shahjahanpur (U.P.)

STUDIES ON THE OUTBREAK OF VIRAL FEVER IN SHAHJAHANPUR :

An outbreak of viral fever occurred in Shahjahanpur during Aug-Oct, 1992. The high frequency and rapid mortality due to the fever drew attention of our Centre. A detailed survey was carried out to find out the cause of this fever. Following activities were carried out in order to investigate the cause of the epidemic.

(i) Collection of blood samples : About 5-10 ml of blood was collected through vein puncture from fever cases of different age groups. These samples were then sent to NIV, Pune & K.G.M.C., Lucknow for the isolation/identification of the virus.

(ii) Entomological studies : To find out breeding habitats of Aedes aegypti, house surveys were carried out in Jalalnagar area of Shahjahanpur city from 1 October to 16 October. During these surveys a total of 1669 houses covering 13,152 human population (6908 M + 6244 F) were searched for mosquitogenic conditions. Residents of the area store water in various types of receptacles like tanks, pitchers, coolers and intradomestic pits. Apart from indoor surveys, searches were also made for outdoor breeding of Ae. aegypti. Results of the indoor and outdoor surveys are summarised in Table-13. Breeding of Ae. aegypti was

TABLE 13: SHAHJAHANPUR: RESULTS OF MOSQUITO BREEDING SOURCE SURVEY IN JALALNAGAR COLONY (1.10.92 TO 16.10.92)

1. No. of houses surveyed, 1969
2. Human population, 13152
   Male 6908
   Female 6244

S.No.	Type of breeding source	No. checked	No. +ve for Aedes aegypti	Per cent positivity for Aedes aegypti
1.	Wells	81	2	2.5
2.	Tanks	13	1	7.7
3.	Pitchers	135	1	0.7
4.	Desert coolers	38	0	0.0
5.	Intradomestic containers or troughs	6	0	0.0
6.	Tyre collections	28	10	35.7

Laboratory evaluation of new bioinsecticide preparations:Three bioinsecticide preparations viz 'Biocid-S'(F.C.), a formulation of B.sphaericus 1593M supplied by Prof.K.Jayaraman(Anna University, Madras), 'Bactoculicide'(F.C.), a formulation of B.thuringiensis H-14 supplied by M/s.Chemicals International Ltd., Delhi and CDRI(PPS), four samples of Plaster of Paris preparation of B.sphaericus 1593 + B.thuringiensis H-14 supplied by Central Drug Research Institute, Lucknow were tested in the laboratory in enamel trays to determine the effective dosages for field application: Table 14 show the results of laboratory evaluation of the three preparations. Like other preparations of B.sphaericus tested so far, the Biocid-s was most effective against Culex quinquefasciatus followed by An.stephensi and An.culicifacies. It produced >90% mortality against Cx. quinquefasciatus and An.stephensi at the dose of 0.025 ml and 1 ml per square meter respectively, but failed to produce similar results against An.culicifacies even at a dose of 5ml/sq. meter. Bactoculicide the Bti preparation was highly effective against larvae of all the three species and produced >90% mortality against An. culicifacies, An. stephensi and Cx.quinquefasciatus at the dose of 0.05, 0.01 and 0.0025 ml/sqm, respectively. Of the four sample of CDRI Plaster of Paris preparation, three samples viz 911008(A), 911209(B) and 920510(C) produced >90% mortality at a dose of 0.1 g/sqm against all the three mosquito spp. but the fourth sample (D) was not effective against both anopheline spp. even at a dose of 0.5g/sqm.

Comparative toxicity of Spherix(B.sphaericus) and Bacto-culicide(B.thuringiensis H-14) against mosquito larvae (target spp.) and certain non-target organisms: Laboratory bioassay tests were carried out to determine the comparative toxicity of two bioinsecticides viz. Spherix and Bactoculicide against III instar larvae of An. culicifacies, An. stephensi, Cx. quinquefasciatus and Aedes aegypti (target spp.) and certain non-target natural predators of mosquito larvae like larvivorous fish Gambusia and Poecilia, Frog tadpoles, Notonectid bugs and Mesocyclops (copepods). The tests were carried out at a temperature of 27±2 degrees centigrade by exposing the test spp. to serially diluted suspensions of the two bioinsecticides. Table 15 gives the LC_{50} and LC_{90} values (mg/L) of the two bioinsecticides against different target and non target spp. The LC_{50} values of Spherix against larvae of An. culicifacies, An. stephensi and Cx. quinquefasciatus and Aedes aegypti were 2.0, 0.19, 0.05 and >40 mg/L respectively and of Bactoculicide were 0.32, 0.16, 0.06 and 0.03 mg/L respectively. Spherix was most toxic to larvae of Culex followed by An.stephensi and An.culicifacies but this preparation was not toxic against Aedes aegypti even at the concentration of 40 mg/L. In contrast Bactoculicide, the Bti preparation was most toxic against larvae of Aedes aegypti followed by Culex, An.stephensi and An. culicifacies. Both the bioinsecticides were not toxic to various non-target organisms

TABLE 14: DELHI: LABORATORY EVALUATION OF DIFFERENT BIOINSECTICIDE PREPARATION AGAINST LARVAE OF AN. CULICIFACIES, AN. STEPHENSI AND CULEX QUINQUEFASCIATUS

Bioinsecticide preparation	Dose per sq. metre	Per cent Mortality					
		An.culicifacies		An.stephensi		Cx.quinquefasciatus	
		24 h	48 h	24 h	48 h	24 h	48 h
Biocid-s(F.C)	5ml	10	36	-	-	-	-
B.sphaericus 1593 M	1ml	2	10	26	94	-	-
	.25ml	-	-	4	48	-	-
	.05ml	-	-	-	-	88	96
	.0025ml	-	-	-	-	68	94
	Control	0	14	0	2	4	8
Bactolarvicide(F.C.)	.1ml	98	100	84	100	-	-
B.thuringiensis H-14	.05ml	96	100	79	94	100	100
	.01ml	70	84	58	90	100	100
	.05ml	-	-	32	82	100	100
	.0025ml	-	-	-	-	90	96
	.00125ml	-	-	-	-	8	38
	Control	8	10	0	0	0	2
CDRI(P.P)Sample A	.5g	98	98	94	98	-	-
911008 (Bs+Bti)	.1g	76	90	72	90	100	100
	.02g	-	-	-	-	100	100
	Control	0	0	0	0	0	0
CDRI(P.P)Sample B	.5g	98	100	96	98	-	-
911209 (Bs+Bti)	.1g	94	96	80	96	99	100
	.02g	-	-	-	-	88	92
	Control	0	0	0	0	0	0
CDRI(P.P)Sample C	.5g	100	100	100	100	-	-
920510 (Bs+Bti)	.1g	94	100	82	94	98	98
	.02g	-	-	-	-	18	28
	Control	0	0	0	0	0	0
CDRI(P.P)Sample D	.5g	0	0	0	0	-	-
(Bs+Bti)	.1g	0	0	0	0	38	46
	.02g	-	-	-	-	0	2
	Control	0	0	0	0	0	0

(FC)=Flowable liquid concentrate; (P.P)=Plaster of Paris.

even at much higher concentrations than required against mosquito larvae (Table 15) LC_{50} values of both Spherix and Bactoculicide against, Gambusia, Poecilia, Frog tadpoles and Mesocyclops were >1000 mg/L.

Effect of temperature and pH on the larvicidal activity of Spherix and Bactoculicide: Laboratory bioassay tests were carried out at different pH and temperature in BOD to study the effect of temperature and pH on the larvicidal activity of Spherix (B.sphaericus) and Bactoculicide (B.thuringiensis H-14) against larvae of An. culicifacies, An. stephensi, Cx. quinquefasciatus and Ae. aegypti. An increase in the temperature from 21°C to 31°C significantly increased the activity of two bioinsecticides

TABLE 15: DELHI: COMPARATIVE TOXICITY OF SPHERIX (B. SPAERICUS) AND BACTOCULICIDE (B. THURINGIENSIS) AGAINST CERTAIN TARGET AND NON-TARGET ORGANISMS

Organisms	Lethal concentration(mg/Litre) after 48 hours			
	Spherix		Bactoculicide	
	LC 50 (95% confidence limits)	LC 90	LC 50 (95% confidence limits)	LC 90
1. Target Organisms				
An.culicifacies	2.0 (1.635-2.446)	7.8	0.32 (0.26-0.39)	1.1
An.stephensi	0.19 (0.135-0.239)	0.8	0.16 (0.123-0.207)	0.92
Cx.quinquefasciatus	0.056 (0.046-0.067)	0.22	0.062 (0.049-0.078)	0.27
Aedes aegypti	>40		0.034 (0.026-0.043)	0.098
2. Non-target organisms				
Gambusia affinis	>1000		>1000	
Poecilia reticulata	>1000		>1000	
Frog tadpoles	>1000		>1000	
Mesocyclops	>1000		>1000	
Notonectidae bugs				
Enithares indica	>100		>100	
Anisops spp	>50		>50	

TABLE 16: DELHI: EFFECT OF TEMPERATURES ON THE LARVICIDAL ACTIVITY OF 'SPHERIX' AND BACTOCULICIDE AGAINST DIFFERENT VECTOR SPECIES

Bioinsecticide	Spp.	LC_{50} values(mg/L) with 95% confidence limits after 48 hour exposure at two different temperatures	
		21°C	31°C
Spherix	A.c.	- > 40 *	- 0.48(0.39-0.59)
	A.s.	- > 10 *	- 0.04(0.033-0.0.56)
	C.q.	- > 0.088(.072-.106)	0.032(0.026-0.39)
	A.a.	- > 40 *	- > 10 *
Bactoculicide	A.c.	- 0.8 (0.635-1.01)	0.17(0.13-0.22)
	A.s.	- 0.25(.192-.324)	0.076(0.061-0.094)
	C.q.	- > 0.19(.156-.230)	0.022(0.017-0.027)
	A.a.	- > 0.07(.056-.088)	0.021(.018-0.025)

A.c = An. culicifacies, A.s = An. stephensi, C.q = Cx quinquefasciatus, A.a = Ae. aegypti

* LC_{50} For spherix against An. stephensi at 21°C was roughly 10.2 mg/L and against Ae. aegytpi at 31 was roughly 32 mg/L respectively.

against all susceptible mosquito species(Table 16). The LC_{50} values of spherix against larvae of An. culicifacies and An.stephensi Cx. quinquefasciatus and Ae. aegypti at 21° were >40, >10, 0.08 and >40 mg/L respectively, but at 31°C these values were 0.48, 0.04, 0.03 and 28 mg/L respectively. Thus there was a significant increase in the toxicity of spherix against two anopheline species but the toxicity against Ae. aegypti was only slightly affected. Bactoculicide however, was quite toxic against all the four larvae even at 21° but the larvicidal activity was further enhanced at 31°C(Table 16).

Table 17 shows the effect of pH on the larvicidal activity of two bioinsecticides against larvae of An.stephensi and Cx. quinquefasciatus. An increase in the pH of water beyond 9.5 significantly reduced the larvicidal activity of two bioinsecticides against both the species. However,the larvicidal activity between 4.5 to 9.5 pH remained more or less constant.

Laboratory evaluation of the persistance of larvicidal activity of Spherix(B.sphaericus) against An. stephensi: B.sphaericus have been reported to recycle and persist in larval habitats. Under small scale field conditions, the efficacy of Spherix (B.sphaericus) persisted for varying duration from 1 to 6 weeks. Since, these trials did not clearly indicate the recyclying and persistence, a laboratory trial was undertaken to study the persistance of the larvicidal activity of Spherix. This trial was carried out against An. stephensi in 5 litre containers. The tests were performed during January-March, 1992 at room temperature which ranged from 18-26°C. The bioinsecticide suspension was applied on the surface of water @ 0.5g/sqm. For each test 25, III instar larvae were exposed in both, treated as well as control containers and the mortality among the larvae was recorded after 72 hours to account for any delayed response.

TABLE 17: DELHI: EFFECT OF pH ON THE LARVICIDAL ACTIVITY OF 'SPHERIX' AND 'BACTOCULICIDE' AGAINST AN. STEPHENSI & CX. QUINQUEFASCIATUS

Biocide	Mosquito species	Conc. mg/l	Percent mortality after 48 hours. 3.5	7.5	9.5	10.5
Spherix	An.stephensi	.5	93.3	89	96	25
	Culex	.08	95	90	89	40
Bactoculicide	An.stephensi	.5	78	90	94	8
	Culex	.25	100	98	88	12

TABLE 18: DELHI: EFFICACY AND PERSISTANCE OF LARVICIDAL ACTIVITY OF 'SPHERIX' AGAINST AN. STEPHENSI UNDER LABORATORY CONDITIONS

Period in weeks	% mortality after 72 hr. exposure period	
Post-treatment	Treated @ .5 sq gm (average of 4 replicates)	Control (average of 2 replicates)
3.1.92		
0	88	0
1	94	2
2	82	12
3	76	10
4	60	0
5	34	0
6	82	2
7	96	0
8	94	20
9	89	2
10	89	2
11	77	6
12	95	54

Test was discontinued due to higher control mortalities

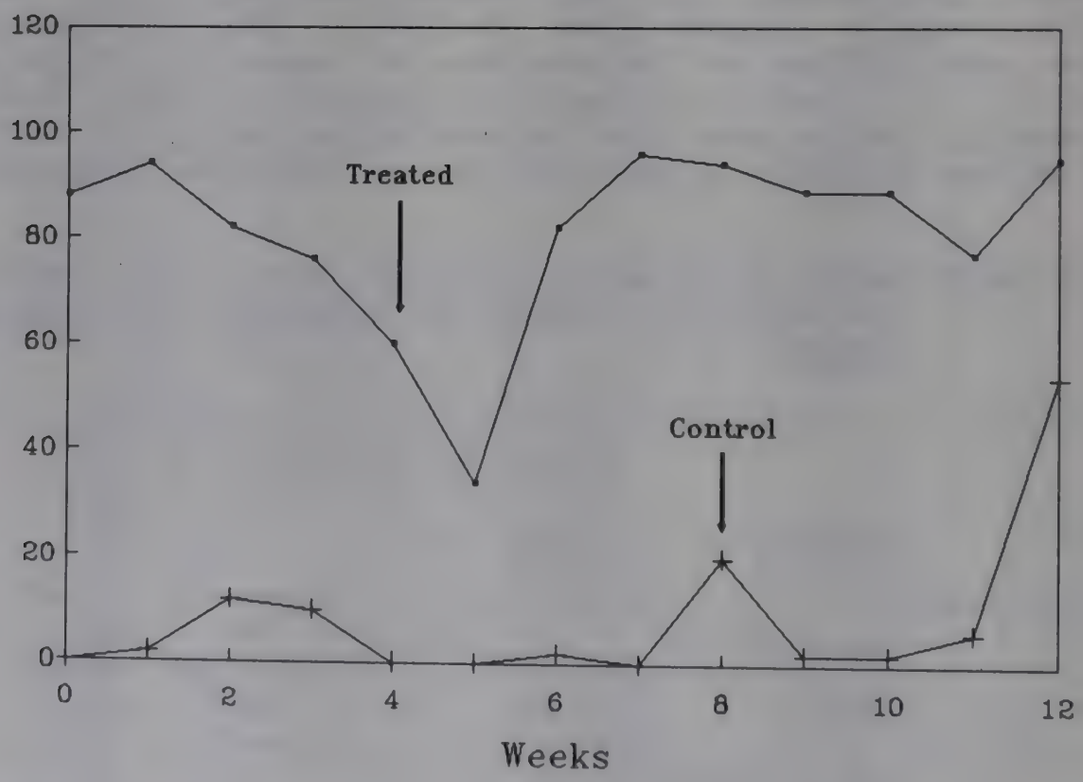


Fig. 1: Delhi: Efficacy and Persistance of larvicidal activity of Spherix (B. sphaericus) against An. stephensi under laboratory condition

The dead larvae in the treated and control containers were allowed to settle down and the alive larvae were removed after 72 hours. The tests were repeated at weekly interval upto 12 weeks.

In the laboratory conditions the larvicidal activity of Spherix persisted for 12 weeks when the tests were discontinued due to high mortality in one of the control container as well(Table 18, Fig. 1). During this period the per cent mortality against An. stephensi declined from 88% to 34% after 5 weeks but later on much higher % mortalities(77-96%) were obtained up to 12 weeks.

Bioassay of different batches of Spherix(B.sphaericus): During April, 1992, 41 samples of Spherix different batches of these preparations(Date of preparation - January-February, 1992) were received for the examination of their biological activity and other characteristics. The biological activity of some randomly selected samples was determined using bioassays against larvae of Cx. quinquefasciatus(early IV instar). All the tests were carried out under standard laboratory conditions at $27\pm2^{o}C$. The biological activity (LC_{50}-mg/L) of Spherix against Cx. quinquefasciatus ranged between 00.98 to 0.016mg/L (Table 19).

CYCLOPOID COPEPODS(CRUSTACEA):

Laboratory evaluation of the predation efficiency of cyclops: Cyclopoid copepods as a biological control agent of

TABLE 19: DELHI: BIOLOGICAL ACTIVITY OF DIFFERENT BATCHES OF SPHERIX (B. SPHAERICUS) DETERMINED BY LC50 ON 4TH INSTAR LARVAE OF CULEX QUINQUEFASCIATUS

Batch No.	Biological activity	Manufacturer's value* (February 1992)
1	0.014	0.01
4	0.014	0.009
5	0.016	0.01
6	0.012	0.009
8	0.013	0.008
9	0.011	0.01
11	0.015	0.011
15	0.016	0.088
28	0.013	0.01
40	0.013	0.008
41	0.0098	0.0085

* Determined by LC_{50} on 4th instar larvae of Culex pipiens molestus

mosquito larvae have been the subject of some recent studies. With this in view a laboratory study was undertaken to determine the predation efficiency of cyclops against mosquito larvae. The study was carried out against first instar larvae of An. stephensi, Cx. quinquefasciatus and Ae. aegypti. Mesocyclops spp (Copepods) were collected from a water treatment pond at Wazirabad and were maintained in the laboratory in pond water enriched with algal phytoplankton. Their predation efficiency against the first instar larvae of different spp. was studied by varying the prey-predator densities. In the first test, the predator density was kept constant(50 copepods/500 ml water) and the prey densities varied from 25 to 200 larvae. In the second test the prey densities were kept constant(25 larvae/100 ml water) and the predator density varied from 1 copepod to 20 copepods/100 ml. Both the tests revealed that predation efficiency of Mesocyclops against larvae of Ae. aegypti An.stephensi and Cx. quinquefasciatus was in the density of (Tables 20-21).

Cage simulation study to demonstrate the persisting control of Aedes aegypti with copepods. A cage simulation study to demonstrate the possible interaction of copepods and Ae. aegypti were carried out using two breeding colonies of Ae. aegypti housed in two big cages 60x60x60 cms. Each cage contained 50 adult mosquitoes(25 Male + 25 Female) and it was provided with an enamel bowl for oviposition and breeding. Initially 2 litre pond water enriched with algal phytoplanktons was added to each bowl and additional larval food(Dog biscuits + yeast tablets powdered)

TABLE 20: DELHI: PREDATION EFFICIENCY OF MESOCYCLOPS (COPEPODS) AGAINST FIRST INSTAR LARVAE OF AN. STEPHENSI AE. AEGYPTI AND CX. QUINQUEFASCIATUS - EFFECT OF VARYING PREY DENSITY

No. of first instar larvae added per bowl	Percent mortality (Consumption in 24 hours)		
	An.stephensi	Aedes aegypti	Cx.quinque-fasciatus
25	90.3	97.6	64.0
100	73.25	94.0	58
200	63.6	67.3	-

Note: Fifty copepods were added per bowl containing 500 ml. water.

TABLE 21: DELHI: PREDATION EFFICIENCY OF MESOCYCLOPS AGAINST FIRST INSTAR LARVAE OF DIFFERENT MOSQUITO SPECIES - EFFECT OF VARYING THE PREDATOR DENSITY

No. of copepods per bowl per 100 ml. water	Percent mortality (Consumption in 24 hours)		
	An. stephensi	Ae. aegypti	Cx. quinquefasciatus
1	30.0	38	29
2	40.0	64	34
5	53.0	81	44
10	85.0	97	71
20	89.0	100	88

Note: Twenty five larvae were added to each bowl.

was added to each bowl. In one of the cage the bowl was inoculated with 50 Mesocyclops and the other was kept as untreated control. Weekly monitoring of immatures and adult mosquitoes was done. After recording the number, both adults and immatures were released back into the respective cages. Additional water was added to each bowl to make up the loss due to evaporation. Observations continued upto 8 weeks until when all the mosquitoes died in the experimental cage and no more larvae could reach to the adult stage due to persistant effect of copepods against the freshly emerged larvae in the experimental cage(Table 22).

LARVIVOROUS FISH

Mass production of larvivorous fish: Mass production of following species of larvivorous fish was continued during 1992 at Seelampur fish farms in collaboration with Fisheries Department of Delhi Administration.

Gambusia affinis

Tilapia spp

Danio rerio

Release of larvivorous fish in Delhi: During 1992 approximately 30,000 larvivorous fish, Gambusia affinis were released in stone

TABLE 22: DELHI: EFFECT OF MESOCYCLOPS ON AE. AEGYPTI POPULATION IN A CAGE SIMULATION TRIAL

Weeks	Number of mosquitoes			
	Experimental cage		Control cage	
	Adults	Immature	Adults	Immature
0	50	0	50	0
1	38	7	41	359
2	29	3	32	755
3	27	4	26	888
4	14	12	104	747
5	7	92	151	852
6	5	10	127	947
7	1	0	84	670
8	0	0	32	678

quarries in Vasant Kunj area in Delhi in collaboration with Municipal Corporation of Delhi, to control the breeding of Anopheles species. The impact of larvivorous fish on malaria transmission in this locality is being monitored by MCD.

FOCAL OUTBREAK OF MALARIA

A case of P.falciparum malaria from Nehru Place area of Delhi was recorded at MRC clinic,2-Nanak Enclave in October,1992. After an interval of a week another three persons came from the same area were also suffering from P.falciparum malaria. This promoted us to make an epidemiological investigation.

It was found that construction work was going on for a multistoryed five star hotel, in Nehru Place, South Delhi for the last three years. Altogether 462 labourers were staying there at the basement of the building. More than 96% of them were immigrants from Uttar Pradesh, Bihar,Orissa,Rajasthan and Madhya Pradesh.

Parasitological and Entomological surveys were carried out at the construction site during Oct-Nov. 1992. The MRC team

TABLE 23: DELHI: STATE-WISE POSITIVITY OF MALARIA AMONGST IMMIGRANT LABOURERS

	Emigrated from	Number of Persons	BSE	Pv	Pf	Mix	Total Positive
1.	Uttar Pradesh	241	80	8	42	2	52
2.	Bihar	97	35	7	14	0	21
3.	Orissa	70	20	2	5	0	7
4.	Rajasthan	23	7	0	5	0	5
5.	Madhya Pradesh	17	4	1	1	0	2
6.	Punjab	2	2	1	0	0	1
7.	Haryana	3	2	1	0	0	1
8.	West Bengal	6	3	0	1	0	1
9.	Nepal	3	2	1	1	0	2
	Total	462	155	21	69	2	92

carried out a rapid fever survey in the labour population and made peripheral blood smear from the febrile cases. Malaria positive cases were treated with requisite doses of antimalarials. The patients were followed for 7 days subsequently. Blood slide examination showed a high prevalence of P.falciparum malaria where 71 out of total 92 positive cases (77.1%) were P.falciparum. Three of these Pf cases were resistant to chloroquine at R_1 level. Subsequently they were treated with long acting sulfonamide pyramithamine combination (Table 23).

During the outbreak of malaria, entomological investigation was also carried out to detect the vector mosquitoes responsible for this outbreak. Several large and small water collections were detected particularly in the basements of the hotel complex and in nearby areas where extensive breeding of An.stephensi and An.subpictus was detected. Of the 11 adult An.stephensi mosquitoes collected, two were found positive for gland and one for gut infection.

(vii) MADRAS, TAMIL NADU

The incidence of malaria in Madras city has shown an increasing trend. The total number of positive cases recorded in the city which was 51272 in 1990 rose to 67013 in 1991 and to 72314 cases in 1992. There has been a raise in P. falciparum incidence also. During 1990 the total number of P. falciparum cases recorded in the city was 3921 which doubled in 1991 with 8024 cases. The number of corporation divisions registering an API of 20 and above was 35 during 1991 and 30 in 1992.

The bioenvironmental control operations were continued in 6 corporation divisions i.e., (53, 54 & 55 and 86, 87 & 88) till October 1992 and in 3 divisions i.e., 86, 87 & 88 thereafter. At present the operation is confined to Chintadripet area with a population of about 1 lakh.

From January to October 1992 the number of overhead tanks with water ranged from a monthly average of 1538 to 2332. The number that required reintroduction of fishes ranged from 100 to 208 (from 6.7% to 13.5%) on a monthly average. The percentage of overhead tanks found breeding ranged from 2.7 to 4.7 on a monthly average. (Table 1)

In case of wells, the number with water ranged from 1302 to 1629 on a monthly average in all the 6 corporation divisions. Reintroduction of fishes was necessary in 40-81 wells. In other words between 2.5% and 6.2% wells required fish reintroduction. The mosquito breeding in wells was drastically brought down and ranged from 0.1% to 0.5%. (Table 1)

In the control area the percentage of overhead tanks found breeding ranged from 18.3 to 42.1. In case of wells the per cent found positive for mosquito breeding ranged from 1.0 to 30.7.

In Chintadripet area during the period November and December maximum number of overhead tanks and wells monitored was 724 and 486 respectively. Mosquito breeding was detected in a maximum of 2.1% overhead tanks as against 50% recorded in control area.

In case of wells no breeding could be detected. Whereas in control area 18.8% to 23.1% were found breeding.

Cistern breeding was relatively lesser in the experimental divisions. The total number of cisterns monitored on a monthly average ranged from 6275 to 7979. Whereas in the rest of two months the number monitored was 3024 and 3337. The percentage of cisterns found positive for mosquito breeding fluctuated between 0.1 to 0.2 as against 0.2 to 5.57 recorded in control area. The details are presented in Table 1.

TABLE 1: MADRAS : CONTROL OF AN. STEPHENSI BREEDING BY FISHES IN OVERHEAD TANKS (OHTS), WELLS

	Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Over-Head Tanks	No. with water	1538	1738	1673	1594	1621	1626	1613	1720	2232	1945	670	724
	No. fish re-introduced	208	188	160	145	136	131	126	121	100	139	50	57
	Reintroduction %	13.5	10.8	9.6	9.1	8.4	8.1	7.2	7.0	6.7	10.4	9.9	9.9
	% Breeding Expt.	2.7	2.9	3.7	3.6	3.7	3.6	3.1	3.1	4.7	4.6	2.1	1.4
	Cont.	31.3	21.7	36.2	32.4	33.6	42.1	32.4	29.7	-	18.3	.50	43.3
Wells	No. with water	1542	1629	1623	1618	1558	1549	1581	1586	1474	1302	449	486
	No. fish re-introduced	69	66	51	67	47	53	40	47	46	81	30	25
	Reintroduction %	4.5	4.1	3.1	4.1	3.0	3.4	2.5	3.0	3.1	6.2	6.7	5.4
	% Breeding Expt.	0.3	0.3	0.1	0.2	0.3	0.1	0.5	0.2	0.1	0.3	-	-
	Cont.	13.8	1.0	17.4	17.0	14.9	30.7	20.2	6.2	-	18.3	18.8	23.1
Cisterns	No. with water	6878	7165	7182	7279	7342	7420	7575	7979	6402	6275	3024	3337
	% Breeding Expt.	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.14	0.11	0.03	-
	Cont.	0.2	1.3	0.5	-	-	-	2.2	0.2	-	5.57	3.6	-

Adult mosquito density: The per man hour density of An. stephensi ranged from 0.9 to 21.8 in the experimental area in different fortnightly collections. In the control area the per man hour density of An. stephensi ranged from 2.0 to 34.4 (Table 2).

Health education: During 1992 health education activity was continued by the project. Awareness programmes were also held in

TABLE 2: MADRAS: ANOPHELINE RESTING COLLECTION (MHD) FROM FIXED CATTLESHEDS IN EXPERIMENTAL AND CONTROL AREA

Year/Month 1992		Experimental		Control	
		Anopheline	An. stephensi	Anopheline	An. stephensi
Jan	I	3.7	3.5	17.5	17.0
	II	3.2	2.8	21.0	20.0
Feb	I	3.2	2.8	18.0	16.0
	II	2.8	2.6	11.0	11.0
Mar	I	3.6	3.6	14.0	14.0
	II	1.6	1.6	16.0	16.0
Apr	I	1.6	1.4	2.0	2.0
	II	2.2	2.2	11.3	11.3
May	I	2.6	2.6	28.0	28.0
	II	1.2	1.2	3.0	3.0
Jun	I	9.8	1.6	3.9	3.9
	II	9.7	1.5	9.3	2.6
Jul	I	3.1	0.9	4.0	3.3
	II	3.4	2.4	11.1	5.3
Aug	I	3.2	2.5	18.5	18.5
	II	4.6	3.2	11.3	11.3
Sept	I	12.7	11.3	24.0	21.3
	II	15.1	13.4	34.4	34.4
Oct*	I	30.5	21.8	24.0	23.0
	II	16.2	13.2	30.6	30.0
Nov	I	7.5	7.0	12.0	12.0
	II	14.8	13.9	25.6	25.6
Dec	I	5.6	4.9	29.3	25.3
	II	2.2	1.6	10.8	10.8

* Sowcarpet survey stopped from 13.10.92

collaboration with different Social Service Organizations/Welfare Organizations. The agencies collaborated were: Welfare Associations of Mogappair & Srinivasa Nagar, Youngster Association for Social Service (YASS), the Adiparasakti cult, Civic Exnora.

The project organized 15 health education camps in collaboration with different organizations where about 4500 people participated. In addition to demonstration, 989 blood smears were also collected in 8 out of 15 health education camps. Of these, 8 where found positive for malaria parasites (P. vivax - 6, P. falciparum - 2.).

EXHIBITION

1. During the year the project participated in Chief Minister's Free Medical Camp cum Exhibition in collaboration with the Corporation of Madras.

2. An exhibition cum Health Education camp was organized in Pudippakkam in collaboration with Sri Om Sakthi Mandram.

During the year 45 Students of Loyalla College Madras, undergoing Diploma course in Medical Laboratory Technology were trained in bloodsmear collection, staining and identification of malaria parasites.

Besides these, Health Education camps were organized in schools, Associations and slums on a regular basis in the experimental area. About 1500 persons participated.

The project associated with YASS in organizing a Health Camp Manali, for the benefit of Brick kiln workers where about 100 persons participated.

HEALTH EDUCATION ACTIVITY OF THE PROJECT

Sl. No.	Type of activity	Participated
1.	Health Education Camps	15
2.	Fever Survey	7
3.	Collaborating Agency	8
4.	No. of Persons attended	4597
5.	No. of Video Shows	5
6.	No. of Exhibitions	2
7.	No. of Training	1

TABLE 3: MADRAS: RESULTS OF BLOOD SMEAR EXAMINATION IN MALARIA CLINICS DURING 1992

Month	Clinic					
	Anna Nagar			Chintadripet		
	BSE	Pos	Pf	BSE	Pos	Pf
Jan	90	14	0	278	123	51
Feb	72	25	1	190	96	13
Mar	88	25	0	265	133	18
Apr	58	24	0	217	123	7
May	81	28	0	214	112	13
Jun	109	53	0	258	97	3
Jul	167	71	0	240	89	5
Aug	230	71	6	267	82	3
Sept	237	65	3	188	71	4
Oct	364	63	10	346	87	8
Nov	244	35	6	177	47	9
Dec	175	17	0	114	19	0
Total	1915	491	26	2754	1079	134
SPR	25.6%			39.2%		

The Bioenvironmental control project functions in close collaboration with Directorate of Public Health and Preventive Medicine, Govt. of Tamil Nadu and Health Department, Corporation of Madras, The Project received active cooperation and support from both these organizations.

Fish introduction through voluntary agencies: A successful attempt was made to involve residents of Srinivasanagar through their Welfare Organization in fish introduction into wells. Active members of Welfare Association were first educated on mosquito borne diseases and control of mosquito breeding. Thereafter an awareness was created in the community. Gambusia fishes were distributed for introduction into about 200 wells in a single operation.

7 - POINT ACTION PLAN

The Corporation of Madras has taken up the work on the closure of overhead tanks and wells in a major way. The Corporation has issued notices to house owners asking them to close their OHT and well with immediate effect. Three private contractors have been identified for undertaking the job of

manufacturing OHT covering. The estimated cost for closing OHT measuring 1 sqm is about Rs. 450/-.

Malaria clinic: The Centre has established a malaria clinic in Chintadripet in addition to the clinic already functioning at the premises of the office. The number of blood smears examined and number found positive have been provided in Table 3. During the period a total of 3669 bloodsmears were collected out of which 1570 were found positive for malaria. In the Anna Nagar malaria clinic 491 were found positive out of 1915 blood smears examined (26 P. falciparum) (SPR 25.63%). In Chintadripet clinic a total of 1079 positives were detected out of 1754 blood smears examined of which 134 were P. falciparum. (SPR 61.5%).

Epidemiological impact: The number of positive cases recorded monthwise and other epidemiological parameters for both the experimental areas are given in Table 4. It is apparent that

TABLE 4: MADRAS: EPIDEMIOLOGICAL DATA OF EXPERIMENTAL DIVISIONS

	Clinic					
Year/Month 1992	Chintadripet (79,80 &81)			Sowcarpet (30,48 & 49)		
	BSE	+ve	Pf	BSE	+ve	Pf
Jan	1334	89	0	4448	505	226
Feb	1547	156	19	4268	655	135
Mar	1718	159	3	4905	656	130
Apr	573	139	-	4485	744	252
May	1451	296	9	5424	901	248
Jun	2588	427	4	5376	830	137
Jul	1875	213	55	6078	632	68
Aug	2471	314	3	8622	1032	187
Sept	2507	197	1	8215	1039	213
Oct	3009	151	3	7660	992	209
Nov	2483	161	-	8561	1020	293
Dec	1602	191	1	6202	607	149
Total	23158	2493	97	74344	9613	2247

Year	Chintadripet				Sowcarpet			
	ABER	API	SPR	SfR	ABER	API	SPR	SfR
1989	-	-	-	-	-	-	-	-
1990	21.96	7.66	3.48	0.005	64.91	83.73	12.90	2.27
1991	36.87	22.89	6.20	0.41	83.12	138.26	16.60	3.16
1992	27.70	29.82	10.76	0.41	92.46	119.56	12.93	3.02

there was a reduction in the incidence and SPR in divisions 53, 54 and 55 during 1992 compared to 1991. These 3 divisions contributed 10702 positive cases with 2034 P. falciparum cases in 1991 as against 9613 cases with 224 P. falciparum cases in 1992. Whereas the other experimental area registered an increase in total malaria case from 1867 cases in 1991 to 2493 cases in 1992. This increase could largely be attributed to increase in malaria incidence in slums. This is reflected by the fact that as many as 1156 out of 2493 cases (46.37%) were recorded from 4 slums.

Large-Scale field trials with Spherix and Bactoculicide: Culex quinquefasciatus is one of the major nuisance mosquito in Madras city. The waterways such as Coovum, Adayar, Buckingham canal and Otteri Nullah are some of the major sources of breeding. All these waterways carry sewage. In addition to these waterways, chocked storm water drainage also facilitates proliferation of this mosquito. Chemical treatment of all breeding sources is one of the methods of control employed. Continued use of chemicals may not only facilitate in the development of resistance but also causes environmental pollution. Hence, alternate strategies are receiving greater emphasis. Several formulations of Bacillus sphaericus and Bacillus thuringiensis var. israelensis have been tried for mosquito control with encouraging results. Two strains formulated in Russia, Spherix (Bacillus sphaericus) and Bactoculicide B. thuringiensis var israelensis) have been taken up for large scale field trials against Cx. quinquefasciatus in Madras city.

Study site: River Coovum from Tirumangalam Bridge to Connemara Hotel stretching to about 7 km is selected for treatment with Spherix. Otteri Nullah from Anna Nagar West (100 ft. Road) to New Avadi Road Bridge) covering a distance of about 5 km will be treated with Bactoculicide. All breeding sources except drinking water bodies located within one km on either side of Coovum and Otteri Nullah will be treated with bacterial insecticide. The major emphasis is on storm water drain. The Railway canal serves as control for both Coovum and Otteri Nullah.

The study area has been divided into zones and sub zones as indicated below:

1.	Coovum River	5 zones 29 sub zones
2.	Otteri Nullah	4 zones 12 sub zones

The operation is organized in such a way that one zone is covered/day. The treatment of river Coovum and Otteri Nullah is completed in 5 and 4 days respectively. The Biocide is sprayed on alternate weeks in both Coovum and Otteri Nullah. The post treatment observation/evaluation is carried out in the succeeding weeks following treatment.

The following agencies are involved in operation and evaluation :

1. Corporation of Madras : Biocide spraying in Coovum and Otteri Nullah as well as in all water bodies in the study areas.

2. The MRC will undertake evaluation.

3. The Director of Public Health and Preventive Medicine will coordinate the activities.

The corporation will place one senior entomologist as in-charge of operation, supervision and logistics.

The corporation will also provide required number of supervisory staff such as sanitary inspector, field assistants and mazdoors.

The areas selected for spraying with biocide was surveyed and all potential mosquito breeding sources were mapped. Thereafter, a work schedule was drawn up both for operation and evaluation.

Evaluation: Both adult and larval densities were measured zonewise for evaluating the efficacy of the formulation. Larval density is checked by using dipper of 300 ml capacity attached to long handle in 40-80 sampling points in each zone (extending to about 600-1200 mt length)

The adult mosquitoes are collected by hand catch. Total catch collection is also undertaken using pyrethrum. Hand catch collections are undertaken in 8 catching stations/zone (4 stations near Coovum river and 4 away from Coovum. In 2 zones only 4 catching stations have been fixed). Total catch is undertaken in 2-3 structures in the trial area/fortnight.

The larvae collected are transferred into plastic containers and transported to laboratory. The larvae are separated instar wise and counted. The details were recorded in the proforma provided.

Coovum River (Spherix trial area):

7 km stretch of sprayable surface area having about 50000 sqm

No. of zones	:	5
Sub zones	:	29
Major canals joining	:	1. MMDA - Azad Nagar Canal 2. Wallace Garden Nullah 1 km

TABLE 5: MADRAS: EFFICACY OF B. SPHAERICUS AGAINST CULEX QUINQUEFASCIATUS IN COOVUM RIVER

Coovum River	B. sphaericus area	
Immature density		
	Coovum River	Feeder canals/drains
Pre treatment		
Larvae/dip	208	720
Pupae/dip	64	261
Adult density	Per Man Hour 243	
Immature density		
Post treatment		

	Coovum		Feeder Canal	
After rounds of spraying	Larvae/dip	Pupae/dip	Larvae/dip	Pupae/dip
I	36	4	342	33
II	200	10	317	13
III	23	6	60	18

Adult density

After rounds of spraying	Per Man Density
I	112
II	63
III	22

Both Spherix and Bactoculicide will be treated at the rate of 1g/sqm of water surface. The spraying is confined to 1m inside the river from the margin. The spraying will be completed in 5 working days in case of Spherix and in 4 working days in case of Bactoculicide. The spraying is undertaken on alternate weeks in Coovum river and is carried out in the succeeding week following treatment.

TABLE 6: MADRAS: EFFICACY OF BACTOCULICIDE AGAINST MOSQUITO IN OTTERI NULLAH

Immature density

Pre treatment

	Otteri Nullah	Feeder Canal/drain
Larvae/dip	250	-
Pupae/dip	84	-

Adult density PMD: 260

Immature density

Post treatment

	Otteri Nullah		Feeder Canal	
After rounds of spraying	Larvae/dip	Pupae/dip	Larvae/dip	Pupae/dip
I	67	10	293	13
II	46	2	90	19

Adult density

After rounds of spraying	Per Man Density
I	86
II	83

TABLE 7: MADRAS: IMMATURES AND ADULT DENSITIES IN CONTROL AREA (RAILWAY CANAL)

Condition of the area	Immature density		Adult (PMD)
Pretreatment :	Larvae/dip	515	32
	Pupae/dip	186	
Post treatment :			
After one rounding of spraying	Larvae/dip	239	
	Pupae/dip	35	72

Otteri Nullah

Bactoculicide (B. thuringiensis var israelensis) area.

5 km stretch - Sprayable surface area about 50000 sqm

No. of zones - 4

Major Canals - a) Canal from sewage treatment plant (about 2 km).

b) Sewage treatment plant extending to and area of about 1 sqkm.

Evaluation: Pretreatment surveys were carried out to determine the immature density and per man hour density of Cx. quinquefasciatus. Two post treatment observations have been made in both the areas. The results are provided in Tables 5 to 7.

(viii) MANDLA, MADHYA PRADESH

Bizadandi block of District Mandla comprising 80% Gond is highly malarious district. Both P. vivax and P. falciparum are prevalent with peaks in dry and wet seasons. After malaria outbreak in 1987 in M.P., the situation has not improved. This has serious repercussion in all age groups especially for people who are staying in remote and inaccessible villages. After the successful demonstration of malaria control by bioenvironmental methods the number of villages were reduced from 105 to 20 with 11,000 population. Progress at a glance for the period under review is given in Table 1.

TABLE 1: MANDLA: PROGRESS AT A GLANCE (1992)

No. of villages covered	:	20
Population covered	:	11,000
Environmental Management		
No. of margins cleared	:	1,787
No. of drains cleaned	:	1,127
No. of ditches filled	:	514
Channelization	:	802
Biological Control		
No. of hatcheries maintained	:	47
No. of fishes stocked over	:	5 Millions
No. of fishes introduced	:	59,300
Chemotherapy		
No. of blood slides collected	:	6,497
No. of malaria +ve cases treated	:	1,742
Pv	:	855
Pf	:	837
Mixed	:	13
Health Education & Community Participation		
Group meetings	:	269
Participants	:	3,396
Health Camps	:	11
Participants	:	698
Shramdan	:	21
Participants	:	352

TABLE 2: MANDLA: MAN HOUR DENSITY IN EXPERIMENTAL VILLAGES OF BIZADANDI BLOCK (1992)

Month	Total Anopheline	Vectors	
		An. culicifacies	An. fluviatilis
Jan	41.81	36.59	0.06
Feb	50.87	44.27	0.03
Mar	45.86	40.46	0.03
Apr	41.94	36.39	0.05
May	45.50	40.81	0.12
Jun	34.00	29.25	0.12
Jul	67.07	53.93	0.00
Aug	131.40	96.50	0.37
Sep	72.43	56.50	0.12
Oct	54.25	48.33	0.00
Nov	35.25	26.00	0.00
Dec	25.75	20.25	0.00

TABLE 3: MANDLA: EPIDEMIOLOGICAL SITUATION OF EXPERIMENTAL VILLAGES UNDER BIOENVIRONMENTAL CONTROL (1992)

Months	BSE	Pv	Pf	Mix	+ve	SPR	SfR	Pf%
Jan	1006	34	136	4	174	17.30	13.52	78.16
Feb	781	13	48	3	64	8.19	6.14	75.00
Mar	438	20	13	-	33	7.53	2.97	39.39
Apr	302	25	13	-	38	12.58	4.30	34.21
May	355	70	19	-	89	25.07	5.35	21.35
Jun	423	65	13	-	78	18.44	3.07	16.67
Jul	519	92	12	1	105	20.23	2.31	11.43
Aug	717	123	50	-	173	24.55	6.97	28.41
Sep	1490	147	152	2	301	20.20	10.20	50.50
Oct	963	192	242	2	436	45.28	25.13	55.25
Nov	766	103	234	3	340	44.39	30.59	68.82
Dec	384	21	98	3	122	31.80	25.52	80.32
Total	6497	855	837	13	1742	26.78	13.44	50.17

INTERVENTION AND SOURCE REDUCTION:

The field work was carried out on weekly basis for surveillance as well as for source reduction work i.e. filling, levelling,

emptying, draining and other methods of eliminating breeding sites of mosquitoes. Small stream bed pools, pits were levelled and filled. Rice fields were difficult sites to tackle therefore, a separate study on rice field agro-ecosystem was initiated in three different ecological terrain i.e. forests, foot-hills and plains for operational feasibility of control measures.

Poecilia reticulata (Guppy) was widely used as biological control agent and during the year this fish was released in one big dam of District Mandla for multiplication. Fish collection from hatcheries established during intervention phase of bio-environmental control and the dam revealed the presence of guppy in large numbers which clearly indicates its continuous survival and abundance without periodical maintenance or replenishment. Fish collections were also made from Jabalpur. It was revealed that in many new habitats where guppy got introduced due to floods, it started multiplying and established of its own in large numbers without any special effort.

Since literacy rate in this area is very low, people are superstitious and health ignorant, sustained efforts were made to motivate people by way of frequently organizing health camps, group meetings, exhibitions, video films and by writing slogans on the walls.

ENTOMOLOGICAL SURVEYS:

Monitoring of vector densities was done fortnightly by collecting anophelines and determining man hour densities (Table 2). During the year average vector MHD ranged between 20 to 97. Among total anophelines collected, An. culicifacies constituted the major proportion of density (82%). An. fluviatilis density were very low in almost all the months (0.13%).

PARASITOLOGICAL SURVEYS:

Active door-to-door surveillance was carried out on weekly basis which revealed high incidence of malaria. A total of 855 blood smears were found positive out of 6497 blood smears collected (Table 3). Highest SPR was recorded in the month of October with 55% Pf. Percentage of Pf was highest in the month of December (80%) and lowest in June-July (11-17%).

Impregnated nylon bednets treated with synthetic pyrethroid (lambdacyhalothrin, 25 mg/sqm) were given in 15 hyper-endemic villages and five villages were given plain bednets (control). Epidemiological data revealed that there was a decline in API in both the groups of villages (Table 4). The incidence of malaria

TABLE 4: MANDLA: IMPACT OF BEDNETS ON MALARIA INCIDENCE

Intervention strategies	Year	Pop.	BSE	No. +ve	Pv	Pf	API
Treated bednets							
Pre-intervention	1988	6982	11245	3081	1671	1393	441
Post-intervention	1989		5068	1482	653	822	212
	1990		3424	507	248	258	72
	1991		2572	321	147	174	45
Plain bednets							
Pre-intervention	1988	2295	3502	917	608	305	399
Post-intervention	1989		1559	540	281	259	235
	1990		1019	206	118	86	89
	1991		917	144	79	65	62

was reduced by 90% in the impregnated net villages and 84% in the plain net villages. The reduction observed between the two groups of villages was not statistically significant. The major problems in controlling malaria are:-

1. An. culicifacies and An. fluviatilis, the primary vectors of malaria in the region bites indoors and outdoors and feeding occurred from dusk to dawn, when people are active both indoors and outdoors.

2. Community interviews revealed that more than 60% people get up before dawn (0200 hr) for collection of various forest products i.e. mahua and tendu leaves etc. besides 12% people sleep in fields to watch the crop.

3. Daily and seasonal movement for wages and outdoor sleeping habits of the community. The use of bed net is also seasonal and age dependent. Surveys revealed that babies and children were seen sleeping on bare floor in every house without bednet almost every evening. The bednet were fixed only when the adults were ready to sleep usually around 2100 hrs in winter and 2200 hrs in summer and monsoon season. Due to religious affiliation often people were exposed to mosquito

bites by remaining outdoor upto 0200-0300 hrs. Under such situation even 100% protection by bednets when in use may have little impact on the transmission. Therefore, introduction of insecticide impregnated bednets, have limited role to play in malaria control in Mandla district.

IMPREGNATED CURTAINS:

The torn mosquito bednets which needed replacement were used as curtain to cover doors and windows. Our idea was to use the waste material and also to avoid other uses of the curtain and its perception as an obstacle to air circulation or to lighting in the house as climate of the area is hot and human dwellings are without electricity. Curtains were impregnated with lambdacyhalothrin 50 mg/sqm. The impregnation was carried out by measuring the amount of water necessary to saturate the material without dripping, then soaking the curtains in a calculated volume of emulsion in water containing the appropriate amount of pyrethroid. In villages, doors and windows were covered with curtains held by nails.

Curtains were installed during the first week of June, 1992 in two villages and two villages with DDT house spraying were kept as control (Table 5). The house holders were asked to keep

TABLE 5: MANDLA: PER MAN HOUR DENSITY IN VILLAGES WITH DIFFERENT INTERVENTION PROGRAMMES *

Year 1992-93	Intervention measures	
Months	DDT sprayed	Impregnated curtains
May	36.00 **	2.0
Jun	24.00	4.5
Jul	11.33	4.5
Aug	62.37	14.0
Sep	27.50	18.87
Oct	9.37	6.75
Nov ***	6.66	5.00
Dec	5.62	3.00
Jan	3.75	2.66
Feb	3.62	0.33
Mar	4.25	0.75
Apr	9.83	2.00

* - Collections were made only from human dwellings
** - DDT - Ist round in May and 2nd round in September
*** - Curtains were reimpregnated in November

the curtains always hanging. Whenever curtains were damaged or fell down they were repaired or refixed as soon as possible.

Indoor resting collection of mosquitoes was carried out fortnightly to assess the impact of impregnated curtains. The abdominal gonotrophic conditions of mosquitoes were also recorded. Morning house resting density of An. culicifacies was reduced to zero, 15 days later. The entomological results obtained from our trial of lambdacyhalothrin curtain indicated that this method gives substantial reduction of man vector contact for 6 months. Evaluation of the impact of impregnated curtains on malaria transmission is under observation. Additional impact of impregnated curtains was observed on house flies, bed-bugs and spiders. In the course of trial no irritant effect was observed among field staff or the tribals exposed to the impregnated curtains. Acceptance by the house holders was extremely high, with no refusals or complaints.

FIELD EVALUATION OF BIOCIDES:

A biocide B. thuringiensis (BACTOCULICIDE) was field tested against the immature stages of An. culicifacies. Stream and stream bed pools having high mosquito breeding were sprayed @1 gm/sqm with a compression pump. Pre- and post-spray densities of immatures found both in treated and untreated habitats were recorded in prescribed proforma. Only III and IV instar larvae were taken into account. Results are summarized in Table 6. Bactoculicide exhibited 100% reduction upto 3 days. After 7 days of application the effectiveness of biocide declined gradually and it became ineffective with in 10 days.

TABLE 6: MANDLA: FIELD TRIALS OF BACTOCULICIDE (B. THURINGIENSIS) IN CONTROL OF AN. CULICIFACIES BREEDING

	Larval density (III & IV instars)						
	D 0	D 1	D 2	D 3	D 7	D 10	D 14
Experimental *	34.31	00.00	00.00	00.00	21.52	48.10	39.97
Control	27.84	31.61	28.82	19.59	38.60	41.64	26.35

* Dose of application 1 gm/sqm.

OTHER STUDIES:

A preliminary study was undertaken to test the efficiency of the light trap as a tool for sampling malaria vectors, their seasonal abundance as well as the period of peak activity.

A total of 1711 anophelines representing 14 species were collected in 44 trap nights (Table 7). An. culicifacies was the predominant species forming 64% of the total anophelines caught followed by An. subpictus (21%), An. annularis (5.3%) and An. fluviatilis (3.1%). There was a substantial number of males in the present light trap catches (12%). Out of 1101 An. culicifacies, 165 (15%) were males (Table 8).

Analysis of data collected shows that peak activity for An. culicifacies appears to be between 1900-2100 hrs and for An. fluviatilis between 0800-1000 hrs and very few mosquitoes were caught after 0200 hr. It appears that both the species were most active at dusk.

It was observed that there is a correlation between the size of the light trap catches, temperature and rain fall (Table 9) and poor catches were obtained when temperature was 20 degrees centigrade or lower. The light trap can be recommended as a tool for sampling malaria vectors in tribal areas and may be useful for accessing the night time densities of different species in villages where malaria is hyperendemic and human baits are liable to come in contact with drug resistant strains P. falciparum but the whole area is infested by snakes, scorpion and leeches during rains.

Besides, laboratory research is providing inputs for the strengthening of field operation in areas of:-

1. Malaria infection during pregnancy and

2. Sero-epidemiology for trends.

DYNAMICS OF MALARIA INFECTION IN PREGNANCY:

A hospital based study was carried out from September 1991 of one year to determine the pattern of malaria infection during pregnancy in Jabalpur, Central India. Results showed that P. falciparum occurred more frequently in pregnant (76%) than in non pregnant women (54%). While cerebral malaria, abortions, intra-uterine foetal death, maternal anemia were common, only one neonatal death was recorded in a pregnant women. Congenital malaria was not found in infants born to mothers with very heavy parasitaemia at the time of delivery.

TABLE 7: MANDLA: ONE YEAR DATA OF ANOPHELINE SPECIES COLLECTED BY LIGHT TRAP (1992)

Species	Time Interval												
	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	Total
An. culicifacies	104	170	183	128	101	80	71	65	58	42	44	55	1101
An. subpictus	19	60	56	49	31	29	25	8	27	16	16	25	361
An. annularis	7	15	15	11	13	5	7	4	6	2	5	1	91
An. fluviatilis	8	1	12	10	6	11	3	1	1	0	1	0	54
An. theobaldi	3	1	4	5	7	4	3	8	8	4	1	3	51
An. splendidus	3	5	1	1	2	1	0	1	0	0	0	0	14
An. jamesi	0	3	1	1	1	2	0	0	1	0	0	0	9
An. varuna	0	0	0	1	0	0	3	0	1	2	0	0	7
An. jeyporiensis	0	0	0	1	0	1	0	0	3	1	0	1	7
An. turkhudi	1	1	1	2	1	0	0	0	0	0	0	0	6
An. nigerrimus	0	2	0	1	0	0	0	0	0	1	0	0	4
Total	145	256	273	210	162	133	112	87	105	68	67	85	1705

TABLE 8: MANDLA: SEXWISE RECORDS OF ANOPHELINE IN LIGHT TRAP COLLECTION (1992)

Time interval	An. culicifacies		Other anophelines		Total anophelines (%)	
	Female	Male	Female	Male	Female	Male
6-7	76	28	33	8	109(75.17)	36(24.82)
7-8	129	41	81	8	210(81.10)	49(18.90)
8-9	168	15	83	8	251(91.60)	23(08.40)
9-10	117	11	80	4	197(92.90)	15(07.07)
10-11	86	15	61	2	147(89.60)	17(10.36)
11-12	78	2	51	2	129(96.90)	4(03.00)
12-1	63	8	41	0	104(92.80)	8(07.14)
1-2	57	8	22	0	79(90.80)	8(09.20)
2-3	49	9	44	3	93(88.57)	12(11.42)
3-4	36	6	24	2	60(88.20)	8(11.80)
4-5	33	11	20	3	53(79.10)	14(20.90)
5-6	44	11	27	3	71(83.50)	14(16.50)
Total	936	165	567	43	1503(87.84)	208(12.16)

TABLE 9: MANDLA: NUMBER OF AN. CULICIFACIES COLLECTED BY LIGHT TRAP ALONG WITH METEOROLOGICAL DATA *

Months	Rainfall (mm)	Temperature (C)		RH Mean	Number of An. culicifacies per trap night
		Max.	Min.		
Jan	0.0	18.3	8.6	69.4	4.33
Feb	0.0	19.6	9.5	69.4	10.75
Mar	0.0	26.8	15.5	61.3	28.25
Apr	0.2	32.6	22.5	60.7	21.50
May	0.0	34.6	25.3	62.2	13.75
Jun	70.2	34.0	25.0	66.4	38.50
Jul	236.1	31.0	25.0	67.0	21.25
Aug	533.6	26.5	24.2	74.2	45.00
Sep	23.6	29.3	22.6	68.6	75.20
Oct	0.0	24.8	17.4	60.8	16.25
Nov	6.5	18.3	10.5	71.8	14.25
Dec	0.0	16.6	5.5	87.5	8.66

* Rainfall data was obtained from District Meteorological Centre and data on relative humidity and temperature were collected hourly for each trap night.

Even though pregnant women of all age groups and parity remain highly susceptible to malaria throughout pregnancy and puerperium from this area,malaria infection was significantly more prevalent in primigravidas than multigravidas and more severe in third trimester. Result emphasizes the need to target this group of women for malaria control. Chloroquine resistance is common in both pregnant and non-pregnant women. This is an area, where there is great need to introduce effective malaria interventions. As chloroquine resistant parasite spreads, a better understanding of the problem is needed leading to further chemotherapeutic options for pregnant women.

SEROEPIDEMIOLOGICAL STUDIES:

A population based study on malaria transmission, prevalence of infection under conditions of natural exposure to malaria parasites and antimalarial antibodies was carried out in Mandla and Jabalpur of Madhya Pradesh. The prevalence and the levels of antibodies were found to correlate well with epidemiological data.

Malaria antibody levels against Pf antigen and nonapeptide (R1) were measured by enzyme linked immunosorbent assay (ELISA) in two populations, one exposed to intense malaria transmission and the other protected under bioenvironmental control measures. Malaria control is reflected in reduced ELISA values in the protected population. The present result indicates that peptide ELISA is as sensitive as Pf antigen and could be used as a tool for assessing the efficacy of control measures.

(ix) SONAPUR, DISTRICT KAMRUP, ASSAM

In the preceding year (October 1991 to September 1992), besides passive case detection (malaria clinic), weekly active surveillance and mass blood surveys were also conducted in a population of over 22,000. SPR ranged from 12.99% in March to 45% in July, and Pf was the predominant species (74%). MPI was the highest during May till November, and API was as high as 130 per thousand population. In the malaria clinic, SPR ranged from 23.96% to 44%, and 66% of the infections were due to Pf. However, during January to March, proportions of Pv exceeded those of Pf. In mass blood surveys, it was observed that a good proportion of afebrile cases were carriers which were prevalent throughout the year but least during February till June. In the pyrethroid impregnated bednet villages, since initial reduction of over 55%, API remained stable. Residual efficacy of synthetic pyrethroids was highest, while storage, on nylon nettings as opposed to cotton and jute over a period of time while in storage (not in use). For promotion of insecticide impregnated bednets, field demonstrations were given in endemic tea estates (T.E.) of Assam as personal protection method against malaria. Video films, folders, booklets etc. were also supplied as health education materials to several organizations. Several batches of trainees from Health and Family Welfare Training Centre, Government of Assam, and tea garden doctors/technicians were exposed to malaria microscopy. Malaria surveys were also conducted in some tea estates, i.e., Tarajulie T.E., and Paneery T.E. to determine malaria endemicity and vectors of malaria. Malaria positivity in these tea estates ranged from 35 to 56%, and over 85% of the infections were due to Pf. Tea garden population with Pf infection was largely sensitive to chloroquine. An. minimus was the most abundant, and was incriminated as vector of malaria. It was highly anthropophilic and MBR varied between 13 to 19 per man per night. There appeared to be a good correlation between presence of larvivorous fishes (guppy) and absence of mosquito breeding in urban conditions.

INTRODUCTION

During the preceding year, the main focus of the project was to promote personal protection methods (insecticide impregnated bednets) in the existing health services in various sectors, viz., major industries, defence services, primary health care (Government of Assam). Data were collected on malaria incidence in 50 villages of Sonapur PHC through weekly active case detection particularly with reference to insecticide impregnated bednet trials, and to study Pf dynamics. Mass blood surveys were conducted in endemic villages to determine parasite load in the communities, and malaria clinic continued to operate as passive case detection agency. Data on seasonal sporozoite infections in

TABLE 1: SONAPUR: PROGRESS AT A GLANCE*

General		
Study villages	:	50
Population protected	:	22,542
Bednet Trials (Implementation)		
Bednets impregnated for Govt. of Assam	:	3,942
Bednets impregnated for tea gardens	:	5,933
Population protected	:	35,126
Chemotherapy		
Presumptive treatment	:	10,165
Radical treatment	:	5,341
Biological Control		
Satellite hatcheries	:	2
Health Education		
Health camps	:	3
Group meetings	:	7
Video Shows	:	7
Exhibitions	:	1
TV coverages (Regional)	:	3

* From October 1991 to September 1992.

An. minimus were collected. Besides, residual efficacy of various synthetic pyrethroids was determined on different fibres over a time period while in storage (not in use) keeping in view the industrial interests. Malaria surveys were conducted in endemic tea estates of Districts Darrang and Sonitpur to recommend situation specific malaria containment measures. Chloroquine sensitivity to Pf infections in tea garden populations were also studied in-vivo. Health education activities were continued to enhance community participation (Table 1). Data included in this report is from October 1991 till September, 1992.

EPIDEMIOLOGICAL OBSERVATIONS:

Active case detection: Active surveillance were conducted weekly in 50 villages covering population of over 22,000. Results of active surveillance are given in Table 2. Slide positivity rate (SPR) ranged from 12.99% in March to 45.67% in July. Pf infections ranged from 61 to 93%, and were the highest during July to September. Monthly parasite incidence (MPI) were higher during the months of May to November corresponding to active transmission period, the remaining being the lean period (winter months). For the whole year, SPR was 32.24%, and 73.99% of the infections were due to Pf which were recorded in all age groups. Of these, a good proportion (3.66%) of them were gametocyte carriers (Table 3). However, SfR were highest among (0-15) years age group with corresponding proportion of carriers as opposed to > 15 years age group. Carriers were detected during all months but were less frequent during February till May. Annual parasite incidence (API) was 130 per thousand population.

TABLE 2: SONAPUR: RESULTS OF ACTIVE SURVEILLANCE *

Month/Year	BSC/E	+ve	Pf	SPR	Pf%	MPI	BER
Oct '91	843	324	218	38.43	67.28	14.43	3.75
Nov '91	802	307	186	38.27	60.58	13.67	3.57
Dec '91	651	202	135	31.02	66.83	8.99	2.89
Jan '92	543	132	89	24.30	67.42	5.87	2.41
Feb '92	561	114	78	20.32	68.42	5.07	2.49
Mar '92	531	69	44	12.99	63.76	3.07	2.36
Apr '92	492	135	102	27.43	75.55	4.54	2.19
May '92	840	238	155	28.33	65.12	10.60	3.74
Jun '92	927	279	178	30.09	63.79	12.42	4.12
Jul '92	1110	507	474	45.67	93.49	22.58	4.94
Aug '92	934	354	296	37.90	83.61	15.76	4.15
Sep '92	708	222	178	31.35	80.18	9.88	3.15
Total	8,942	2883	2133	32.24	73.99	130.00	39.83

* Population : 22452

TABLE 3: SONAPUR: AGEWISE Pf INCIDENCE IN EXPERIMENTAL VILLAGES

Month/Year	AGE GROUP											
	(0-1) Years			(1-5) Years			(5-15) Years			>15 Years		
	BSC/E	Pf	Pfc	BSC/E	Pf	Pfc	BSC/E	Pf	Pfc	BSC/E	Pf	Pfc
Oct ' 91	20	4	-	113	35	1	282	80	11	428	85	2
Nov ' 91	14	5	-	91	22	1	276	66	4	421	85	3
Dec ' 91	10	1	-	67	18	1	237	62	3	341	48	2
Jan ' 92	12	1	-	94	19	2	140	32	5	297	30	0
Feb ' 92	17	5	1	82	25	1	125	25	0	337	20	1
Mar ' 92	8	0	0	69	6	0	172	13	1	282	23	1
Apr ' 92	9	2	0	84	18	0	145	34	0	254	47	0
May ' 92	13	1	0	111	20	0	272	58	0	444	73	1
Jun ' 92	16	2	0	127	20	2	310	70	4	474	79	1
Jul ' 92	20	8	1	122	53	0	402	183	3	566	224	1
Aug ' 92	16	5	1	126	49	3	326	105	7	466	122	4
Sep ' 92	15	4	0	75	26	2	255	78	7	363	60	1
Total	170	38	3	1161	311	13	2942	806	45	4673	896	17

Source: Active case detection

Passive case detection: Malaria clinic served as passive case detection agency for prompt diagnosis and treatment. As many as 4501 patients reported with fever, and 1754 cases were found parasite positive (Table 4). SPR ranged from 23.96% to 44%, and over 66% of the infections were due to Pf. Positivity were recorded during all months, but attendance was much greater during June till September (monsoon months) with corresponding increase in Pf cases. Nevertheless, during January to March, proportions of Pv infections exceeded those of Pf.

Mass blood surveys: A cross-sectional mass blood surveys were conducted in endemic villages of Sonapur PHC throughout the year to determine the parasite load in the community. Blood smears were collected from both febrile and afebrile cases among all groups. Malaria positivity was recorded during all seasons (Table 5). In total, 5311 blood smears were examined, and SPR was 18.36%; and over 79% of infections were due to Pf. In febrile cases, positivity was much higher during all months, and ranged from 19.44 to 54.07%, and 69% of the infections were due to Pf. However, in afebrile cases, SPR ranged from 2.12 to 33.42%,

TABLE 4: SONAPUR: PASSIVE CASE DETECTION AT MALARIA CLINIC

Month/Year	BSC/E	+ve	Pf	Pv	SPR	SfR
Oct ' 91	290	124	77	46	42.75	26.55
Nov ' 91	236	95	51	44	40.25	21.61
Dec ' 91	150	66	39	27	44.00	26.00
Jan ' 92	126	50	20	30	39.68	15.87
Feb ' 92	109	28	13	15	25.68	11.92
Mar ' 92	121	29	14	15	23.96	11.57
Apr ' 92	140	42	23	19	30.00	16.42
May ' 92	273	94	50	44	34.43	18.31
Jun ' 92	425	150	98	52	35.29	23.05
Jul ' 92	935	364	203	61	38.93	21.71
Aug ' 92	1020	428	349	79	41.96	34.21
Sep ' 92	676	284	230	54	42.01	34.02
Total	4501	1754	1167	486	38.97	25.93

TABLE 5: SONAPUR: RESULTS OF MASS BLOOD SURVEYS

Month/Year	Pop.	Febrile			Afebrile			Total			Indices		
		BSC/E	Pos	Pf	BSC/E	Pos	Pf	BSC/E	Pos	Pf	SPR	SfR	%Pf
Nov '91	889	71	37	20	236	58	48	307	95	68	30.94	22.15	71.58
Dec '91	1039	43	13	9	129	34	28	172	47	37	27.33	21.51	78.72
Jan '92	1523	93	30	23	316	53	43	409	83	66	20.29	16.14	79.52
Feb '92	4259	206	46	36	916	79	55	1122	125	91	11.14	8.11	72.80
Mar '92	2980	72	14	8	570	39	35	642	53	43	8.26	6.70	81.13
Apr '92	2937	101	39	27	544	76	72	645	115	99	17.83	15.35	86.09
May '92	2290	111	45	20	283	6	6	394	51	26	12.94	6.60	50.98
Jun '92	1882	180	58	38	311	21	15	491	79	53	16.09	10.79	67.09
Jul '92	1699	135	73	62	347	116	115	482	189	177	39.21	36.72	93.65
Aug '92	1333	91	35	25	214	40	37	305	75	62	24.59	20.33	82.67
Sep '92	1614	75	22	17	267	41	36	342	63	53	18.42	15.50	84.13
Total		1178	412	285	4133	563	490	5311	975	775	18.36	14.59	79.49

lowest being during the months of February to June, but most were Pf infections (87%).

ENTOMOLOGICAL OBSERVATIONS:

Vector incrimination and Parity: From the day resting catches from human dwellings (indoor), nine different species were dissected for parity and vector incrimination (Table 6). Of these, An. minimus was found sporozoite positive and the infection rate was 2.37%. Most of the sporozoite infections were recorded during the months of April, May and June. A good proportion of all species were parous, mostly 1P, however, fair proportion of An. minimus (Vector species) were 2P but rarely, 3P.

Bednet trials: In continuation of field trials of insecticide impregnated bednets, another experiment was launched in October, 1989 to test the relative efficacy of two different pyrethroids, i.e., deltamethrin (K-othrine), and lambdacyhalothrin (Karate) on malaria incidence. Bednets were impregnated in October, 1989 @ 25mg/sqm and were impregnated on the yearly basis. Data were collected on incidence of malaria based on weekly active case detection (fever survey) in experimental and control (plain-net and no-net) villages.

Effect on malaria incidence: Data on malaria incidence for the year (1988-89) prior to distribution (baseline data), and for subsequent years are given in Table 7. There was a sharp decline (over 70%) in annual parasite incidence (API) in deltamethrin impregnated bednet users during the first two years (1989-91), thereafter it remained more or less stable. However, among lambdacyhalothrin impregnated bednet users, a sharp decrease (55%) was observed in the very first year, thereafter it remained stable. On the other hand, a notable increase was observed among plain-net users in subsequent years. In no-net control areas (but sprayed with DDT by NMEP), API was high but stable.

Residual efficacy of impregnated fibres: Data were collected on the residual efficacy of deltamethrin (two different formulations), and lambdacyhalothrin on different fibres, i.e., cotton, jute and nylon over subsequent months while stored under laboratory conditions. Bio-assays were done using WHO test cones on field caught anopheline species with 3 minutes exposure time and 1 hr observation period. Highest mortalities were observed on impregnated nylon nettings in the month of impregnation and subsequent months, comparatively less in cotton and jute being

TABLE 6: SONAPUR: DISSECTION RECORDS OF DAY RESTING ANOPHELINE SPECIES FROM HUMAN DWELLING (INDOOR)

S.No.	Species	Vector Incrimination			Parity				
		Total dissected	Gland Positive	Infection rate	Total dissected	NP	1P	2P	3P	% Parous
1.	An. annularis	98	-	0.00	66	37	29	0	0	43.94
2.	An. aconitus	1	-	0.00	1	0	1	0	0	100.00
3.	An. culicifacies	31	-	0.00	27	9	15	3	0	66.67
4.	An. fluviatilis	206	-	0.00	155	45	81	29	0	70.97
5.	An. jeyporiensis	4	-	0.00	4	0	4	0	0	100.00
6.	An. maculatus	11	-	0.00	6	0	5	1	0	100.00
7.	An. minimus	464	11	2.37	384	150	179	54	1	60.94
8.	An. subpictus	1	-	0.00	1	0	0	0	0	00.00
9.	An. varuna	197	-	0.00	152	46	88	18	0	69.74

Period of Study : October 1991 - July 1992

TABLE 7: SONAPUR: IMPACT OF BEDNETS ON MALARIA TRANSMISSION IN ADDITIONAL BEDNET TRIALS

Category	Pop.	Time Period	BSC/E	+ve	API
DELTAMETHRIN	1335	Oct '88 - Sep '89	979	370	277.15
@ 25 mg/Sq m	1424	Oct '89 - Sep '90	832	187	131.32
	1415	Oct '90 - Sep '91	507	116	81.98
	1415	Oct '91 - Sep '92	512	94	66.43
LAMBDACYHALOTHRIN	1257	Oct '88 - Sep '89	672	218	173.43
@ 25 mg/Sq m	1702	Oct '89 - Sep '90	840	132	77.56
	1792	Oct '90 - Sep '91	614	139	77.57
	1792	Oct '91 - Sep '92	684	152	84.82
UNTREATED	1332	Oct '88 - Sep '89	747	146	109.61
(Plain net)	1627	Oct '89 - Sep '90	831	196	121.70
	1437	Oct '90 - Sep '91	1345	459	319.42
	1437	Oct '91 - Sep '92	1451	545	379.26
*					
NO NET	2239	Oct '88 - Sep '89	1398	479	223.94
	2139	Oct '89 - Sep '90	1555	470	219.73
	2121	Oct '90 - Sep '91	1013	418	197.08*
	2121	Oct '91 - Sep '92	1078	333	157.00*

* Sprayed with DDT by NMEP each year

the least (Table 8). Lambdacyhalothrin was most potent, while of the two formulations of deltamethrin, flow formulation (Roussel Uclaf, Paris) was slightly more potent. Efficacy decreased notably after six months of impregnation but more sharply in cotton and jute. Mortalities were only negligible in plain-net controls.

Promotion of personal protection methods: Based on the popularity of the programme, insecticide impregnated bednets are being incorporated as personal protection method through primary health care system, and by other industries/establishments, eg., tea gardens. Field demonstrations are being provided on request along with audio-visual aids as health education materials. So far, over 35,000 population have been brought under cover of impregnated bednets (Table 9). It is proposed to organize workshops for state/district level authorities to promote this method of control against malaria and other vector borne diseases.

Surveys of public response: Response surveys among bednet users were made in tea garden populations. It was noted that 95% population used impregnated bednets, and over 85% felt collateral benefits, viz., loss of head lices, bedbugs, cockroaches, house

TABLE 8: SONAPUR: BIO-ASSAY OF PYRETHROIDS ON DIFFERENT FIBRES AGAINST ANOPHELINE SPECIES

S.No.	Pyrethroid	Formulation	Source	Dosage	Netting material *	% Mortality after no. of month **					
						0	1	2	6	8	10
1.	Lamdacyhalothrin	5% EC	ICI England	25 mg	Cotton	99.00	68.53	68.33	35.00	20.00	15.00
					Jute	86.67	58.33	56.67	43.33	18.00	18.33
					Nylon	100.00	98.33	98.33	93.33	78.33	75.00
2.	Deltamethrin	2.5% EC	Roussel Uclaf, Paris	25 mg	Cotton	93.33	83.33	76.67	51.67	30.00	26.67
					Jute	85.00	68.33	66.67	48.33	25.00	21.67
					Nylon	99.17	95.00	95.00	85.00	53.33	48.33
3.	Deltamethrin	2.5% EC	Hoechst, India	25 mg	Cotton	86.67	-	68.33	38.33	28.33	18.33
					Jute	-	75.83	65.00	51.67	13.33	11.67
					Nylon	90.83	-	80.00	75.00	43.33	38.33
4.	Plain Nets	-	-	-	Cotton	-	-	-	3.33	0.00	-
					Jute	-	-	-	5.00	1.67	-
					Nylon	-	-	-	1.67	0.00	-

* Nets were impregnated in February 1992, @ 25 mg/sq m and stored under laboratory conditions;
** Bio-assay done by WHO test cones with 3 minutes exposure time.

TABLE 9: SONAPUR: ADOPTION OF INSECTICIDE IMPREGNATED BEDNETS AS PERSONAL PROTECTION MEANS AGAINST MALARIA BY VARIOUS ORGANIZATIONS/INDUSTRIES OF ASSAM DURING 1991-92

Organization/industry	District of Assam	Population	Pyrethroid used	No. of nets impregnated @ 25 mg/sq m
Deptt. of Health, Govt. of Assam	N.C. Hills	2907	Deltamethrin 2.8% EC (DECIS)	1177
Deptt. of Health, Govt. of Assam	Karbi Anglong	5327	Deltamethrin 2.8% EC (DECIS)	2765
Amchong Tea Estate	Kamrup	938	Plain-nets	250
Sonapur Tea Estate	Kamrup	200	Deltamethrin 2.8% EC (DECIS)	62
Northeast Tennary, Guwahati	Kamrup	52	Deltamethrin 2.8% EC (DECIS)	30
Cement Factory, Patharkuchi	Kamrup	63	Deltamethrin 2.8% EC (DECIS)	26
Assam Polytex Ltd., Jagiroad	Nagaon	85	Deltamethrin 2.8% EC (DECIS)	43
Tarajulie Tea Estate	Sonitpur	3781	Cypermethrin 10% EC (RIPCORD)	972
Paneery Tea Estate	Darrang	2773	Deltamethrin 2.8% EC (DECIS)	700 *
Dimakuchi Tea Estate	Darrang	3000	Deltamethrin 2.8% EC (DECIS)	600 *
Borengajulie Tea Estate	Darrang	4000	Deltamethrin 2.8% EC (DECIS)	700 *
Attareekhat Tea Estate	Darrang	4000	Deltamethrin 2.8% EC (DECIS)	700 *
Bhooteachang Tea Estate	Darrang	4000	Fenvalerate 20% EC (Sumicidin)	1050 *
Corramore Tea Estate	Darrang	4000	Fenvalerate 20% EC (Sumicidin)	800 *
Assam Police Task Force	Barpeta	250	Deltamethrin 2.18% EC	100
Total		35,376		9975

* Estimated number of bednets (impregnation in progress)

flies, and lack of nuisance due to other biting insects. Over 90% were determined to use them regularly, and good proportion of them wanted to buy additional nets. Only 14% felt minor discomfort like itching sensation. Besides, a questionnaire was prepared to assess the impact of health education activities with reference to malaria and its prevention. It was encouraging to note that over 90% of the population had good knowledge of malaria and protection measures against mosquito bites. It appeared that MRC activities had a significant impact in the working populations.

MALARIA SURVEYS IN TEA ESTATES:

Malaria surveys were conducted in the worst affected tea estates of Districts Sonitpur and Darrang located along the forest fringe areas of Arunachal and Bhutan border respectively. Data were collected on malaria incidence, vector incrimination, indoor day resting anophelines, breeding habitats, and chloroquine sensitivity in Pf infections.

Tarajulie T.E. (District Sonitpur):

PARASITOLOGICAL OBSERVATION:

Malaria morbidity: Based on the hospital records of Tarajulie T.E. for the year 1991, of all diseases, malaria appeared to be the major public health problem. Of the total outdoor cases (OPD), 35% were due to fever, of which 24% were malaria positive (Table 10). As many as 14 deaths due to Pf were recorded, most of them being in months of May to August corresponding to maximum number of fever cases. Of the total malaria positives, 44% were Pf infections (as identified in Rangapara PHC).

Passive case detection (Malaria Clinic): In the malaria clinic established by Malaria Research Centre (MRC), 1071 blood smears were collected and examined during the period from 1 May, 1992 to 15 June, 1992. Of these, 374 (35%) were malaria positive. Most of these were due to Pf infections (85%). Malaria positivity were recorded in all age groups including infants. Mixed infections (Pf+Pv) accounted for 2.67% of all positives.

Spleen surveys: Of the 61 children examined between two to nine years of age, 43 (70%) were found to be spleen positive. Of these, 40 were malaria positive along with enlarged spleen and three were malaria negative with spleen positive. However, 10 children were spleen negative but malaria positive; the remaining being both malaria and spleen negatives.

TABLE 10: SONAPUR: MORBIDITY DUE TO MALARIA IN TARAJULIE T.E., ASSAM *

Month/Year	OPD	Total fever cases	BSC/E	+ve	Pf	Deaths
Jan '91	455	148	46	-	-	-
Feb '91	504	65	35	1	1	-
Mar '91	879	100	97	7	-	2
Apr '91	1106	350	246	34	9	1
May '91	1743	620	513	122	41	2
Jun '91	1809	1025	886	246	142	2
Jul '91	1768	1026	168	83	28	3
Aug '91	1614	850	206	52	22	2
Sep '91	1421	205	103	17	10	-
Oct '91	1000	142	92	13	4	1
Nov '91	871	158	29	8	3	1
Dec '91	780	201	24	6	0	-
Total	13950	4890	2445	589	260	14

* Source: Tarajulie T.E. Hospital (Pop. : 3781)

Mass blood surveys: During mass blood surveys in the labour lines and adjoining hamlets, a total of 1359 blood smears were collected representing nearly 20% of the population (Table 11). Of these, 18.32% were malaria positive, and Pf was the dominant infection (96%). Malaria positivity was much pronounced in the hamlets as opposed to garden labour lines. SPR varied between 29% to 42% in the hamlets, the highest being in the Kalabil. Among labour lines, all lines were affected, the least being line No. 4.

Chloroquine sensitivity studies in Pf: Using 3 day test, 40 cases were followed comprising all age groups. Of these, 22 cases (55%) were S/RI, 4 cases (10%) were RI, 2 cases each (5%) were RII and R III respectively. One case with increasing asexual parasitaemia had turned serious and was terminated.

TABLE 11: SONAPUR: MASS BLOOD SURVEY IN TARAJULIE T.E. (LABOUR LINE) AND ADJOINING HAMLETS, ASSAM

Labour line (L.N.)/ Name of the hamlets	Pop.	Febrile			Afebrile			Total			Indices		
		BSC/E	+ve	Pf	BSC/E	+ve	Pf	BSC/E	+ve	Pf	SPR	SfR	%Pf
L.N. 1	936	9	7	7	291	32	31	300	39	38	13.00	12.66	97.43
L.N. 2	868	-	-	-	174	30	28	174	30	28	17.24	16.09	93.33
L.N. 4	103	-	-	-	51	1	0	51	1	0	1.96	-	-
L.N. 6	665	1	-	-	192	37	37	193	37	37	19.17	19.17	100.00
L.N. 7	749	9	8	7	150	14	14	159	22	21	13.83	13.20	95.45
L.N. 8	212	3	1	1	105	17	17	108	18	18	16.66	16.66	100.00
Total	3533	22	16	15	963	131	127	985	147	142	14.92	14.42	96.59
Tengabali	838	5	3	3	94	26	26	99	29	29	29.29	29.29	100.00
Kalabil	1379	6	5	5	84	33	31	90	38	36	42.22	40.00	94.73
Lutera	961	5	2	2	180	33	31	185	35	33	18.91	17.83	94.28
Total	3196	16	10	10	358	92	88	374	102	98	27.27	26.20	96.07
Grand Total	6729	38	26	25	1321	223	215	1359	249	240	18.32	17.66	96.38

ENTOMOLOGICAL OBSERVATION:

Indoor day resting collections: From the human dwellings, five anopheline species were collected, of which An. vagus was the most predominant (78.23%), while An. minimus, An. annularis, and An. culicifacies comprised 9.59%, 6.42% and 5.60% of the total collection. An. varuna were found in low numbers (Table 12). The man hour density (MHD) for these species varied correspondingly, maximum being for An. vagus (14.81%). All these species were collected while resting on walls, hanging clothes and other articles within the house. Most of the An. minimus and An. culicifacies collected either were semi-gravid or gravid.

Whole night collections: In the whole night catches (4 man nights), seven anopheline species were collected over human bait, of which An. minimus was the most predominant comprising 79.10% of the total catch, and man biting rate (MBR) was as high as 13.25. An. minimus fed all through the night beginning 19/20 hrs/till 3/4 hrs. But most part of the feeding occurred midnight onwards till 4.00 hrs. (Table 13). An. annularis fed in the first half of the night but in lower numbers. All other species i.e., An. aconitus, An. nivipes, An. splendidus, An. vagus and An. varuna comprised only 1% to 3% of the total catch over human bait.

Vector incrimination: From the day resting and man biting collections, four anopheline species, i.e., An. annularis, An. culicifacies, An. minimus and An. varuna were dissected for gland to detect sporozoites and to determine parity. Of these, An. minimus and An. culicifacies were found sporozoite positive (Table 14). Of the 142 An. minimus dissected, six were found gland positive (4.23%) and parity rate was over 50%. Only a sole specimen of An. culicifacies out of 68 districts was found gland positive, however, the parity rate was over 70%.

Breeding surveys: Eight different species were recorded breeding in ponds, streams and drains. The vector species, i.e., An. minimus and An. culicifacies, alongwith An. aconitus and An. nivipes were recorded only in streams. An. annularis and An. nigerrimus were recorded in all three habitats. An. vagus (the most common species) was recorded breeding in ponds and drains. An. jeyporiensis was recorded in streams as well as in drains.

Paneery T.E. (District Darrang)

PARASITOLOGICAL OBSERVATION:

Passive case detection: Malaria clinic was established during the period from 6 July, to 30 September, 1992. As many as 2953 blood smears were collected and examined from febrile patients (Table 15). SPR was 56%, and 84% of the infections were due to Pf.

TABLE 12: SONAPUR: MAN HOUR DENSITY AND PER CENT COMPOSITION OF INDOOR DAY RESTING ANOPHELINES IN TARAJULIE T.E, AND ADJOINING HAMLETS, ASSAM

S.No.	Species	No. collected			Abdominal Condition				MHD	% age of total collection
		Labour* lines	Hamlets**	Total	UF	FF	SG	G		
1.	An. annularis	5	74	79	5	13	27	34	1.21	6.42
2.	An. culicifacies	7	62	69	4	8	38	19	1.06	5.60
3.	An. minimus	0	118	118	4	11	69	34	1.81	9.59
4.	An. vagus	289	674	963	-	-	-	-	14.81	78.23
5.	An. varuna	0	2	2	0	0	2	0	0.03	0.16
	Total	301	930	1231	13	32	136	87	18.92	100.00

* man hours: 21; ** man hours: 44; UF - unfed; FF - fully fed; SG - Semi-gravid; G - gravid

TABLE 13: SONAPUR: RECORDS OF WHOLE NIGHT MAN BITING COLLECTIONS IN ADJOINING HAMLETS OF TARAJULIE T.E., ASSAM

S.No.	Species	No. mosquitoes collected per hour											Total collected	% age of total collected	MBR* (Man nights=4)
		18-19	19-20	20-21	21-22	22-23	23-24	0-1	1-2	2-3	3-4	4-5			
1.	An. aconitus	-	-	-	-	-	1	-	1	-	-	-	2	2.99	0.50
2.	An. annularis	1	1	1	-	2	-	-	-	-	-	-	5	7.46	1.25
3.	An. minimus	-	2	4	6	1	6	8	11	8	7	-	53	79.10	13.25
4.	An. nivipes	-	-	-	-	-	2	-	-	-	-	-	2	2.99	0.50
5.	An. splendidus	-	-	1	-	-	-	-	-	-	-	-	1	1.49	0.25
6.	An. vagus	1	-	-	-	-	-	-	-	-	-	1	2	2.99	0.50
7.	An. varuna	-	-	-	-	-	1	1	-	-	-	-	2	2.99	0.50
	Total	2	3	6	6	3	10	9	12	8	7	1	67	100.00	16.75

* MBR : Man biting rate per man per night

TABLE 14: SONAPUR: SPOROZOITE AND PARITY RATE IN INDOOR DAY RESTING AND WHOLE NIGHT ANOPHELINE CATCHES IN TARAJULIE T.E. AND ADJOINING HAMLETS, ASSAM

S.No.	Species	Vector Incrimination			Parity					
		Total dissected	No. gland +ve	Sporozoite rate	Total dissected	NP	1P	2P	3P	% parous
1.	An. annularis	76	0	0.00	53	29	19	5	-	45.28
2.	An. culicifacies	68	1	1.47	35	10	18	7	-	71.43
3.	An. minimus	142	6	4.23	90	43	40	7	-	52.22
4.	An. varuna	3	0	0.00	2	1	1	-	-	50.00

TABLE 15: SONAPUR: PASSIVE CASE DETECTION IN PANEERY T.E., DARRANG, ASSAM

Age group	BSC/E	+ve	Pf	Pv	Mix
0 - 1	111	50	38	12	-
1 - 5	493	275	225	44	6
5 - 15	688	417	348	66	3
> 15	1661	915	788	117	10
Total	2953	1657	1399	239	19

Study period : 6 July - 30 September 1992

TABLE 16: SONAPUR: MASS BLOOD SURVEYS IN PANEERY T.E. DARRANG, ASSAM

Labour line No.	Pop.	Febrile			Afebrile			Total			Indices		
		BSC/E	+ve	Pf	BSC/E	+ve	Pf	BSC/E	+ve	Pf	SPR	SfR	%Pf
Line No. 10	923	45	16	14	287	61	57	332	77	71	23.19	21.38	92.20
New line	1112	4	3	3	220	23	21	224	26	24	11.60	10.71	92.30
Old line	323	4	0	0	110	46	39	114	46	39	40.35	34.21	84.78
Factory line	415	1	0	0	65	8	7	66	8	7	12.12	10.60	87.50
Total	2773	54	19	17	682	138	124	736	157	141	21.33	19.15	89.80

Study period : 6 July - 10 August 1992.

TABLE 17: SONAPUR: MALARIA SURVEYS IN SOME TEA ESTATES OF DISTRICT DARRANG, ASSAM *

S.No.	Name of tea estate	BSC/E	+ve	Pf	Pv	Mix
1.	Borengajulie	336	224	190	32	2
2.	Bhooteachang	470	179	124	53	2
3.	Corramore	46	31	29	2	0
4.	Dimakuchi	70	29	22	7	0
5.	Attareekhat	355	194	164	29	1
		1277	657	529	123	5

* Source: Malaria clinic
Study period : 6 July - 30 September 1992

Malaria positivity was recorded in all age groups. Mixed infection (Pf+Pv) accounted for 1.15% of all positives.

Mass Blood Surveys: A cross-sectional surveys were done in garden labour lines and as many as 736 blood smears were collected and examined from both febrile and afebrile cases (Table 16). SPR was 21.33%, and nearly 90% of the infections were due to Pf. Higher positivity (20%) in afebrile cases indicated greater proportion of asymptomatic carriers.

Chloroquine sensitivity in Pf: Using 3 day test (D0, D4, D7), 63 cases were followed comprising all age groups. Of these 56 (88.8%) were S/RI, 5 (7.93%) were RI, and 2 (3.17%) were RII respectively.

Malaria surveys in some other tea estates: Blood slides were also obtained from adjoining gardens, namely Borengajulie, Bhooteachang, Corramore, Dimakuchi and Attareekhat as passive collections (Table 17). Malaria positivity was quite high in all these gardens, and SPR ranged from 38% to 67%, and over 80% of the infections were due to Pf.

ENTOMOLOGICAL OBSERVATIONS:

Indoor day resting collections: From human dwellings (indoor), seven anopheline species were collected, of which An. vagus was the most abundant (65.35%). An. minimus and An. annularis comprised 27.88% and 4.47% of total collections respectively. All other species, i.e., An. culicifacies, An. fluviatilis, An. splendidus, and An. varuna were recorded in low numbers. The man hour density for these species varied correspondingly, maximum being for An. vagus (26.68%).

Whole night collections: In the five man nights (indoor), six anopheline species were collected over human bait, of which An. minimus alone comprised 70.50% of the total collections, and MBR was as high as 19.60 per man per night (Table 18). An. minimus fed all through the night with peak activity during 21/22 hrs. till 3/4 hrs. An. annularis, An. fluviatilis, An. philippinensis, An. splendidus and An. varuna were also collected over human bait but in low numbers.

Vector Incrimination: From the day resting and whole night catches, six anopheline species were dissected for gland to detect sporozoites. An. minimus was incriminated and sporozoite rate was 3.14%. A good proportion of An. minimus were parous (71%), mostly 1P and 2P.

Breeding surveys: Ten different species were recorded breeding in ponds and/or streams. Streams were found positive for An. minimus (vector species), and all other species except An. barbirostris

TABLE 18: SONAPUR: RECORDS OF WHOLE NIGHT MAN BITING COLLECTIONS IN PANEERY TEA ESTATE, ASSAM

S.No.	Species	No. mosquitoes collected per hour											Total collected	% age of total collected	MBR (Man nights=5)
		18-19	19-20	20-21	21-22	22-23	23-24	0-1	1-2	2-3	3-4	4-5			
1.	An. annularis	-	3	1	2	1	1	1	1	-	-	1	11	7.91	2.20
2.	An. fluviatilis	-	-	1	-	-	2	1	-	-	1	-	5	3.60	1.00
3.	An. minimus	6	7	8	11	13	12	4	10	13	11	3	98	70.50	19.60
4.	An. philippinensis	1	1	-	-	-	-	-	-	-	-	-	2	1.44	0.40
5.	An. splendidus	1	1	1	-	1	-	-	1	-	-	-	5	3.60	1.00
6.	An. varuna	-	2	1	2	2	2	1	1	4	2	1	18	12.95	3.60
	Total	8	14	12	15	17	17	7	13	17	14	5	139	100.00	27.80

MBR : Man biting rate per man per night

TABLE 19: SONAPUR: GUPPY VIS-A-VIS MOSQUITO BREEDING SURVEY IN GUWAHATI TOWNSHIP

No. of sites	Guppy fish	Mosquito breeding	% age association
	Present (+)/Absent(-)	No. of larvae/dip	
3	+	0.67	6
21	+++	0.00	40
23	-	72.44	43
6	-	0.00	11

Study period : August - September 1992

and An. kochi. An. annularis, An. nigerrimus and An. vagus were found breeding both in ponds and streams.

MISCELLANEOUS STUDIES

Training cum demonstration component: A one day seminar on management of cerebral malaria was held for Assam Branch India Tea Association (ABITA) on 19th and 20th May, 1992 in Tezpur and Halem respectively. A total of 53 doctors of ABITA (Zone 3) tea garden hospitals participated in the deliberations. Similar additional seminars/workshops are envisioned in association with ABITA. In addition, several batches of trainees from Health & Family Welfare Training Centre (Guwahati) were exposed to malaria diagnosis and treatment, and recent methods for containment of malaria, along with field visit to experimental villages. Further, field demonstrations were given on 'insecticide impregnated bednets' as personal protection method to several agencies and anonymous persons. Health education cassettes, booklets and folders were supplied in bulk to the indentees to enhance community compliance. A poster session on 'Field trials of Insecticide impregnated bednets' was contributed at the CSIR Golden Jubilee Symposium held at CDRI, Lucknow in February 1992.

Larvivorous fishes vis-a-vis mosquito breeding: A survey was conducted in Guwahati township with reference to presence of larvivorous fishes (guppy) versus presence of mosquito breeding in the open drainages with the objectives to study their efficacy in the field conditions (Table 19). A total of 53 sites were screened. Of these 6% of the locations had low density of fishes coupled with low density of mosquito breeding, 40% of the places had high density of fishes but no mosquito breeding, and 43% had no fishes but had high density of larvae (72.44 per dip), and 11% had no fishes and no breeding. Thus, larvivorous fishes appeared to be promising biocontrol agent to reduce mosquito menace.

COLLABORATIVE PROJECT:

Siblings of Anopheline species: To study the siblings of An. philippinensis/nivipes, An. minimus, An. fluviatilis and An. culicifacies; collections of these species from various locations in the N.E. region are being made to study their polytene chromosomes and enzyme variations. Efforts are being made to colonize these species in the laboratory.

Immunological profiles of human populations: To study the degree of protection conferred by insecticide impregnated bednets vs plain nets and no-nets, finger prick blood samples were sent to Delhi (HQs) to study the immunological status of users with reference to malaria.

(x) ROURKELA, DISTRICT SUNDERGARH, ORISSA

Orissa state in eastern India is known for hyperendemic malaria. A field station was opened in 1988 with view to (a) conduct applied field research on malaria with particular reference to Orissa, (b) develop and demonstrate appropriate disease vector control methods (c) study socio-economic aspects of malaria with particular reference to sustainability of interventions developed and (d) to facilitate transfer of technology developed to user agencies including organization of training/workshop.

A project on the integrated control of malaria was completed in 1991 in Bisra block successfully. Two projects on the insecticide treated bednets are in progress. The research activities and progress at a glance are given in Table 1. The studies are discussed in detail in this report.

EVALUATION OF INSECTICIDE IMPREGNATED BEDNETS IN MALARIA CONTROL:

Trial in Kuarmunda PHC: The trial initiated in May 1990 was continued in a population of 6100 covering 15 villages in Kuarmunda PHC. The villages were divided into groups, each receiving Lambdacyhalothrin (Icon) treated nets, Deltamethrin WP (DM WP), Deltamethrin flow (DM Flow) treated nets, untreated nets and no nets respectively. The bednets impregnation schedule is given below :

a. Icon :
- I impregnation - May 1990
- II impregnation - Jun 1991
- III impregnation - Jan 1992
- IV impregnation - Jun 1992

TABLE 1: ROURKELA: RESEARCH ACTIVITY AND PROGRESS AT A GLANCE (1992)

Villages covered under bednet trials (population)	:	21(21033)
Villages covered under other studies (population)	:	7(5235)
No. of health camps arranged in villages	:	14
Participants in health camps	:	2000
Health education camps in school	:	128
No. of students participated	:	2000
Health education campaign by schools	:	1
Video show arranged	:	20
Video show attended (persons)	:	4600
Group meetings arranged	:	99
Participants in meetings	:	3900
Exhibitions shown	:	4
Breeding ponds maintained	:	15

b. DM WP : I impregnation - May 1990
II impregnation - Aug 1991
III impregnation - Jan 1992
IV impregnation - Jun 1992 (treated with DM Flow)

c. DM Flow: I impregnation - Nov 1990
II impregnation - Oct 1991
III impregnation - Jun 1992

Parasitological impact : Impact on the incidence of malaria based on weekly surveillance has been summarised in Table 2. In area with Icon treated bednets the API decreased from 270.7 in baseline year (May 89 to April 90) to 149.9 in second year of intervention (May 91 to April 92) showing a decline of 44.5%. The SPR also declined by 29.7%. In area with DM WP treated nets the decline in API and SPR was by 28.1 and 12.5% respectively, however, in no-net area API increased by 47.2% and SPR by 10.6%.

In area with DM Flow treated nets where intervention was started in November 90, the decline in API and SPR was 59.2 and 42.4%, respectively, compared to a decline of 8.7 and 8.6% in no-net area respectively, thereby indicating that the insecticide treated bednets caused a considerable impact on malaria. This study will be concluded in April, 1993 and final results will appear in next report.

Entomological impact : Mosquito densities were monitored fortnightly by hand collection since beginning in index villages. Impact of Icon treated nets on the densities of malaria vector An. culicifacies shown in Fig. 1. After first impregnation in May 90, vector density in treated net area declined compared to no-net area. The observable impact lasted for 9 months. Second impregnation in June 91 further checked vector density. Based on the residual toxicity bioassays six-monthly impregnation was scheduled which resulted into a continuous impact on the vector density.

Impact of DM WP treated nets has been shown in Fig 2a. The trend was similar as with Icon, however, due to behavioural problem i.e. itching on skin caused by powdered flakes of WP formulation, further impregnation of bednets with DM WP was abandoned and the reimpregnation in June 92 was done with DM-Flow. As shown in Fig 2b. DM Flow produced good impact on vector densities.

The impact of treated bednets on biting on humans has been reported in the previous report, however, experiment on repellency using exit-entry traps is in progress.

TABLE 2: ROURKELA: MALARIA INCIDENCE IN BEDNET TRIAL AREAS

(A). Impact of Icon and Deltamethrin WP treated nets

Period	Parasite Index (cases/1000 pop.)				SPR			
	ICON	WP	Untreated nets	No nets	ICON	WP	Untreated nets	No nets
May 89 to Apr 90 *	270.7	208.5	252.5	223.6	41.1	46.9	38.5	46.2
May 90 to Apr 91	166.5	234.3	270.8	437.7	29.6	36.2	38.0	53.3
May 91 to Apr 92	149.9	194.4	181.5	329.2	28.9	28.5	33.7	51.1
% Change from Baseline	(44.5)	(-6.7)	(28.1)	(+47.2)	(-29.7)	(-39.2)	(-12.5)	(+10.6)
May 92 to Dec 92	59.8	98.9	89.9	178.1	19.5	31.5	24.5	47.0

(B). Impact of Deltamethrin flow treated nets

Period	Parasite Index (cases/1000 pop.)		SPR	
	Flow	No nets	Flow	No nets
Nov 89 to Oct 90 *	327.6	301.5	46.4	47.8
Nov 90 to Oct 91	312.7	417.1	37.3	51.6
Nov 91 to Dec 92	133.6	275.2	26.7	51.9
% Change from Baseline	(-59.2)	(-8.7)	(-42.4)	(+8.6)

* Baseline data

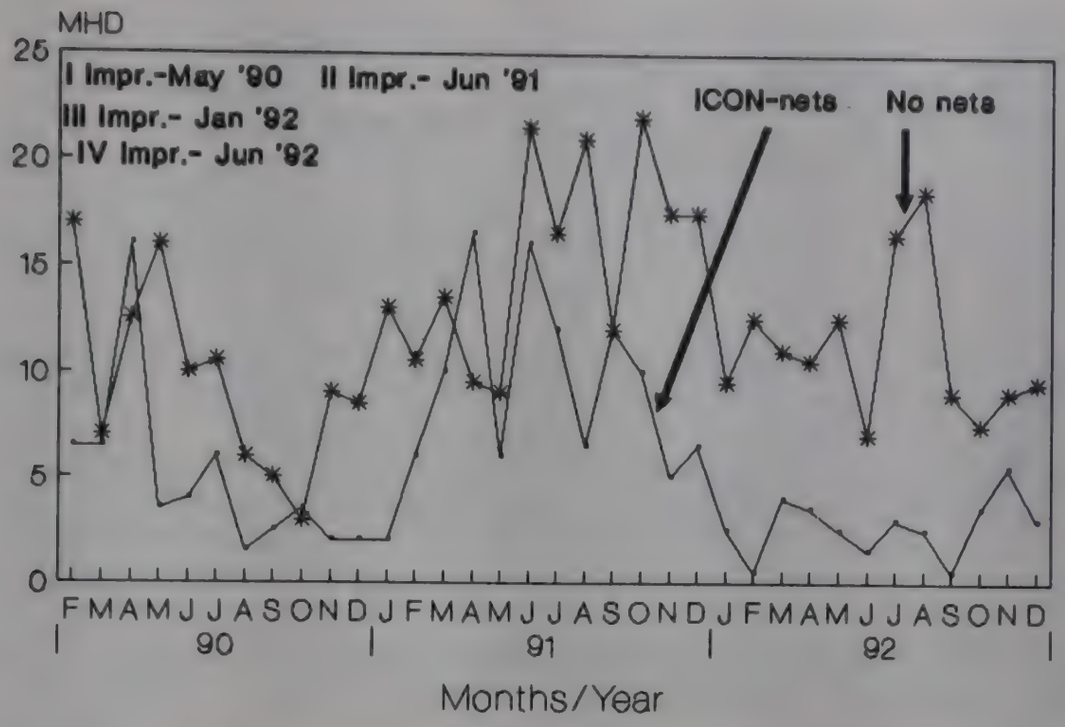


Fig. 1: Rourkela: Impact of Icon treated bednets on the density of An. culicifacies

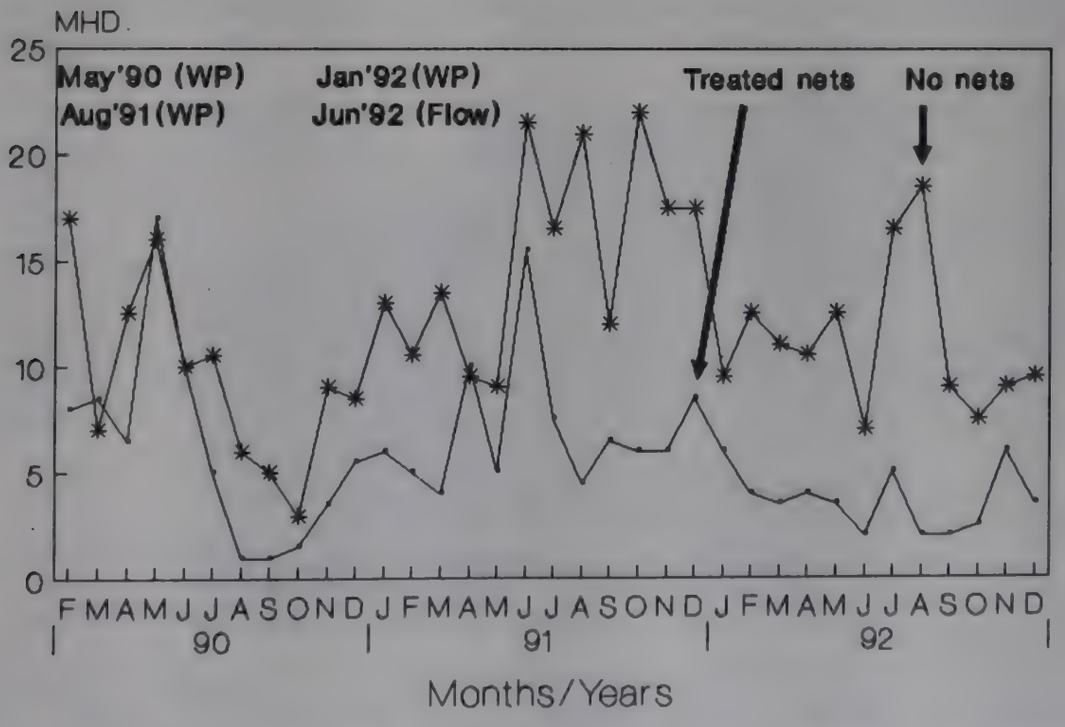


Fig. 2a: Rourkela: Impact of Deltamethrin WP on the density of An. culicifacies

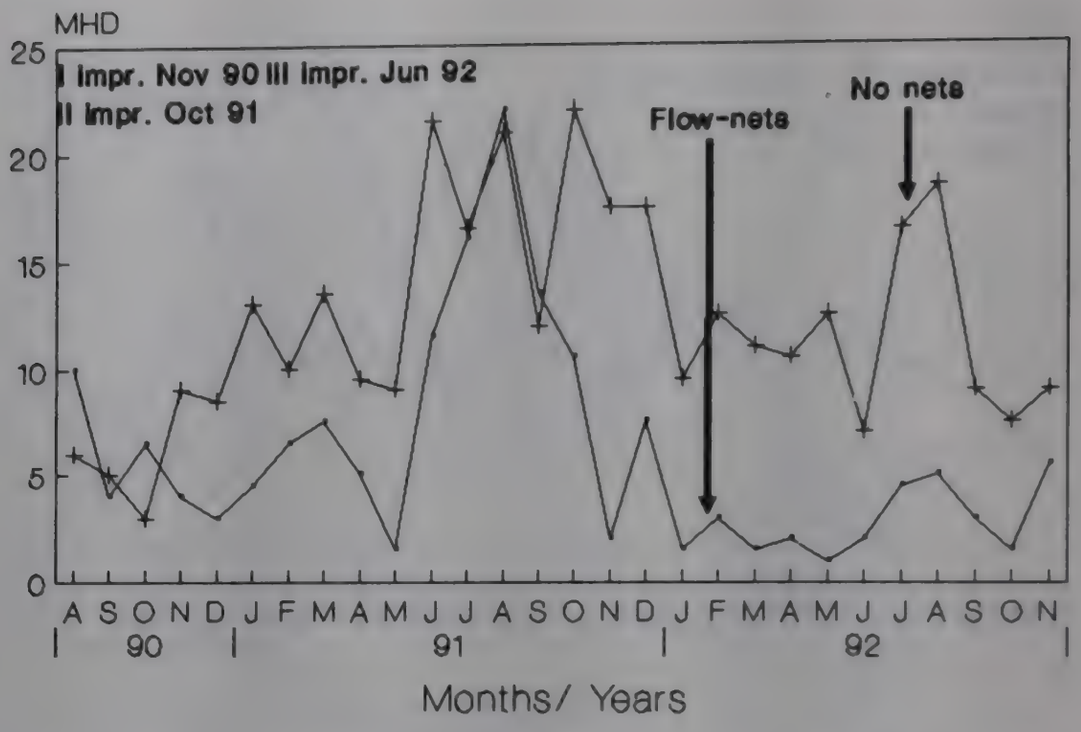


Fig. 2b: Rourkela: Impact of Deltamethrin Flow treated bednets on the density of An. culicifacies

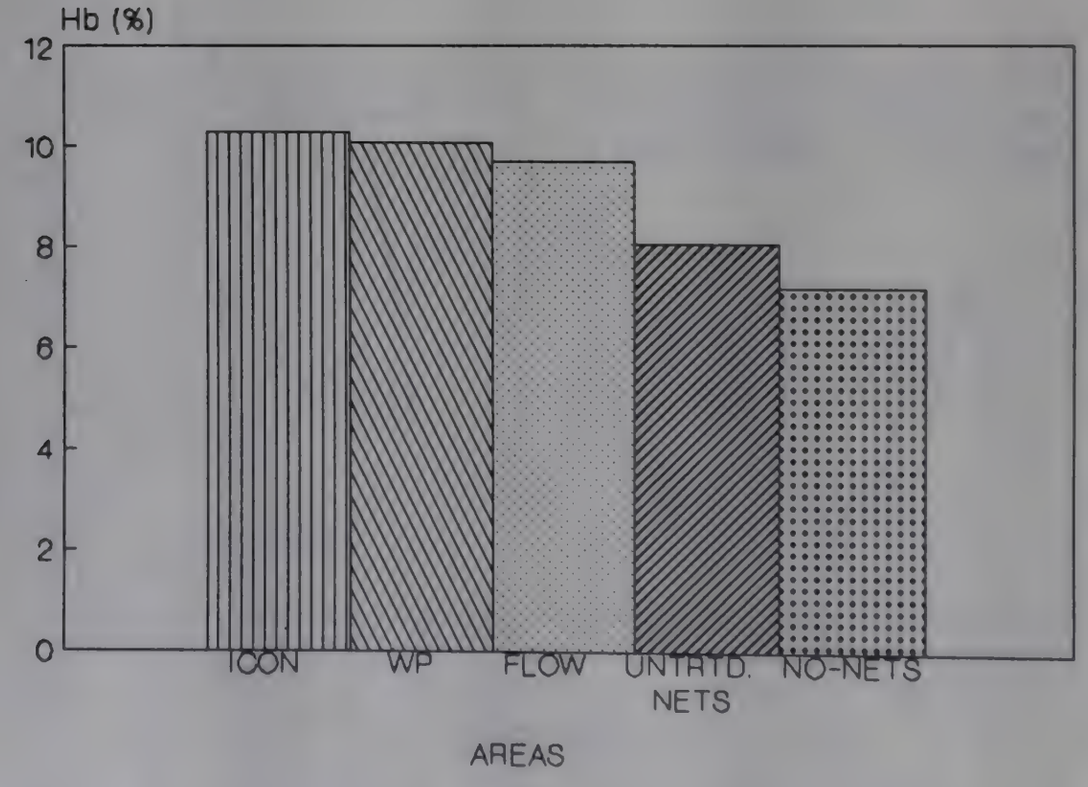


Fig. 3: Rourkela: Impact of insecticide treated bednets on the haemoglobin levels in populations

Impact on clinical measures : In order to assess the impact of treated nets on haemoglobin levels in study populations a survey was conducted in September 91 and Hb levels were determined by Cyanmethaemoglobin method (Fig. 3). It is seen that populations not protected with treated bednets had lower levels of Hb, thereby high anaemia compared to those using the insecticide treated bednets. Treated bednets provided better protection than the untreated nets.

Community participation and social acceptance : Health education efforts were continued by organising meetings, health camps, video shows etc. The health committees co-operated well towards improving bednet compliance, proper upkeep of nets. During each re-impregnation people themselves treated their own nets, helped by a project staff. This further cut down the cost of impregnation of nets.

After 2 years of bednet usage, physical condition of bednets was as follows : good (75%); usable after mending (23%) and unusable (2%).

Bednet trial in mines : An earlier study indicated the presence of hyperendemic malaria in settlements of two major iron ore mines catering to the iron ore needs of Rourkela Steel Plants. On the request of management of Steel Plant, a bednet trial was initiated in 1992. Three settlements viz. Tensa, Barsuan and Kalta with a population of 11762 were included in intervention group and another three viz. Toda, Khandadhar and Sasikala with a total population of 2920 in control without nets.

Baseline entomological monitoring was initiated in February 92 while parasitological survey was done in mid-April. Endemicity level in two areas was comparable (PI - exp. 8.2, control 9.7; SPR - exp. 37.8%, control 21.9%; Spleen rates - exp. 59.3%, control 56.1%; Hb - exp. 9.9 and control 11.4).

Cyfluthrin (Bayer India, Ltd.) was used for impregnation of bednets @ 50 mg/sq mt. and the schedule of impregnation was as given below :

I Impregnation - May 1992

II Impregnation - November 1992

Entomological impact : There are two malaria vectors in mines viz. An. fluviatilis and An. culicifacies. Impact of cyfluthrin treated nets on the densities of these two major vectors has been shown in Fig. 4 (a&b). From February to April i.e. baseline period the densities of An. fluviatilis in both areas were comparable. After distribution of treated nets in May the vector

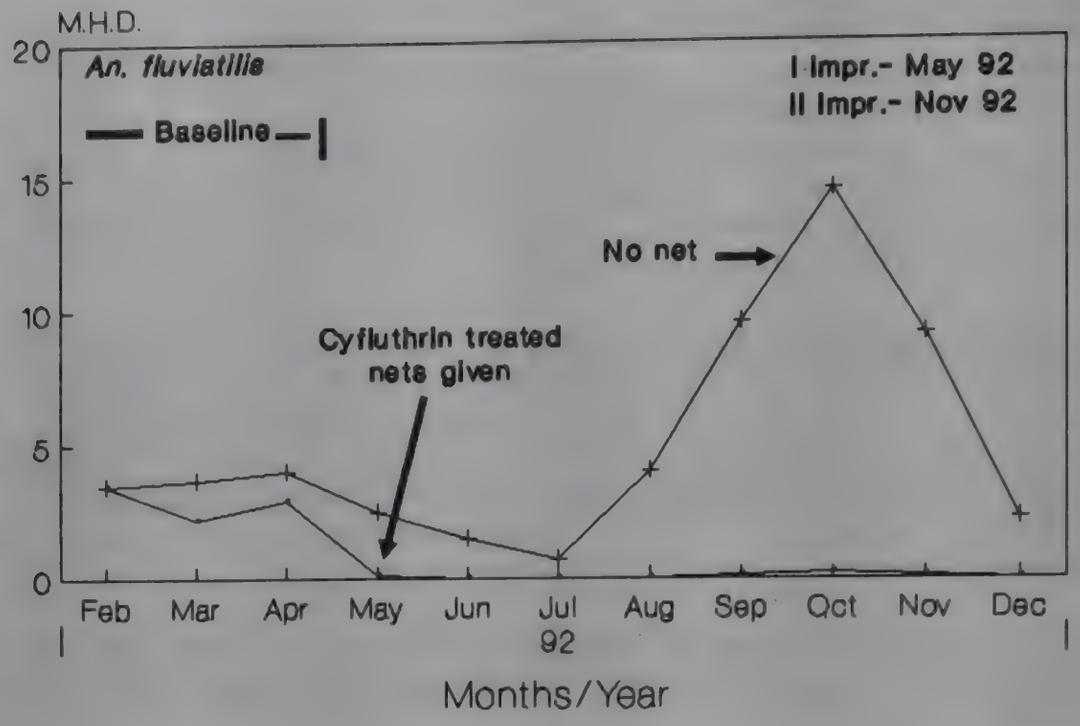


Fig. 4a: Rourkela: Impact of cyfluthrin treated bednets on the densities of An. fluviatilis in mining settlements

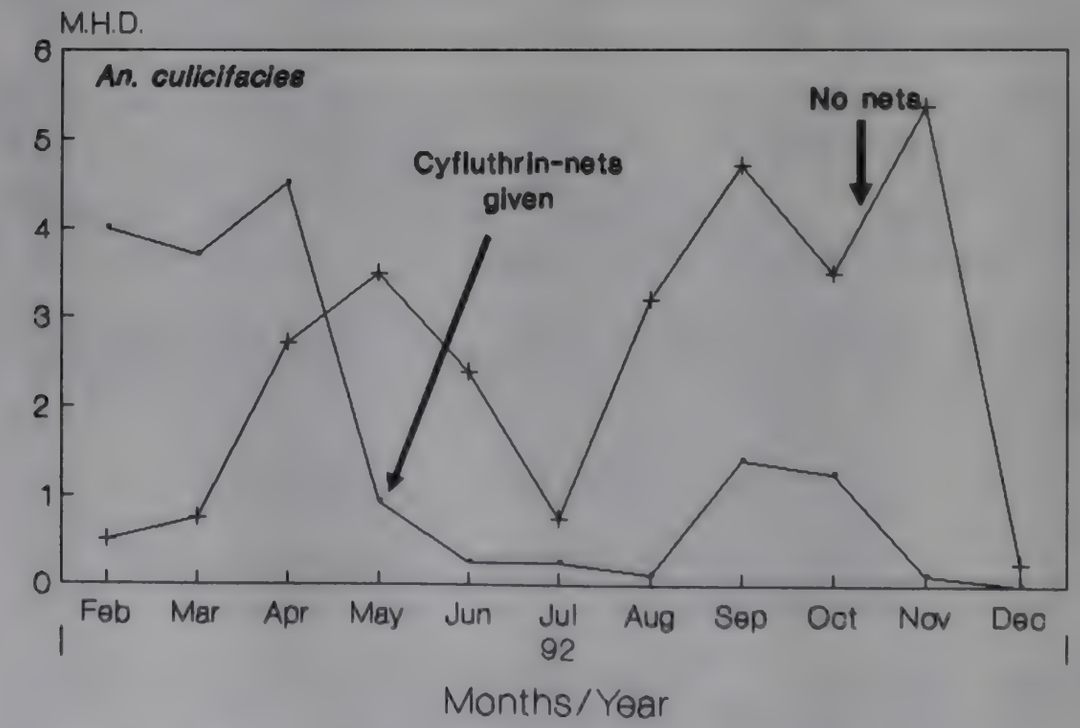


Fig. 4b: Rourkela: Impact of cyfluthrin treated bednets on the densities of An. culicifacies in mining settlements

density in net area declined drastically and remained very low throughout. Treated nets also had significant impact on the densities on An. culicifacies.

Cyfluthrin treated nets also had good impact on the density of total mosquitoes (Fig 5) upto September, however, due to increase in density in October supported by public perception of increase in nuisance mosquitoes, re-impregnation was done in November.

Whole night human bait collections were also done from April keeping one outdoor and one indoor bait in each area (Fig 6). From April 22 to 23 no nets were given and the biting rates were similar. However, after providing treated net on April 24 no An. fluviatilis was caught biting on the baits sleeping under the nets which were kept open on four sides, compared to a high biting rate in control area. Further studies using exit-entry traps are being organised.

Parasitological impact : Fortnightly malaria surveillance was organised from mid April, as each settlement either has a hospital or a dispensary close by. Malaria incidence in mining settlement based on active and passive surveillance is presented in Fig. 7a. It is evident that the treated bednets made considerable impact on incidence and slide positivity rates (Fig. 7b) in the intervention area than control(no net area).

Impact on indoor malaria cases in hospitals : Another significant impact of the trial is the reduction of malaria cases admitted indoors in two hospitals in intervention area (Table 3). It is seen that there was a reduction of 41.6% in all-cause fever cases admitted from April to November 1992 compared to corresponding period in 1991. In malaria cases the reduction was 47.1%. The hospital wards which were packed with acute/cerebral malaria cases were mostly reported to be vacant, however, further study on the impact on morbidity is in progress.

Social acceptance : The trial was organised with the full co-operation of the management of mines and Rourkela Steel Plant under SAIL. Community acceptance of bednet and compliance of bednet use was extremely good. Re-impregnation of bednets in November was organised with public participation and help by the management of the mines. The experiment was found successful in bringing down malaria and mosquitoes and the message has reached widely to large number of other mines located in the forested hilly terrain of the region. Socio-economic impact is under evaluation.

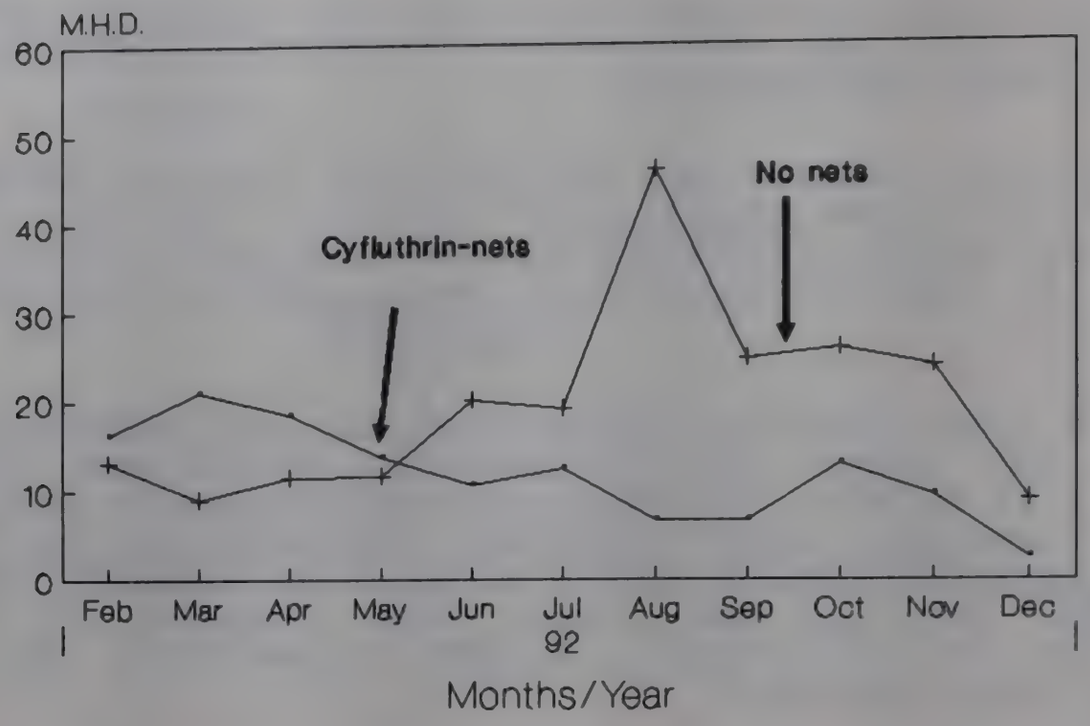


Fig. 5: Rourkela: Impact of cyfluthrin treated bednets on the density of total mosquitoes in mining settlements

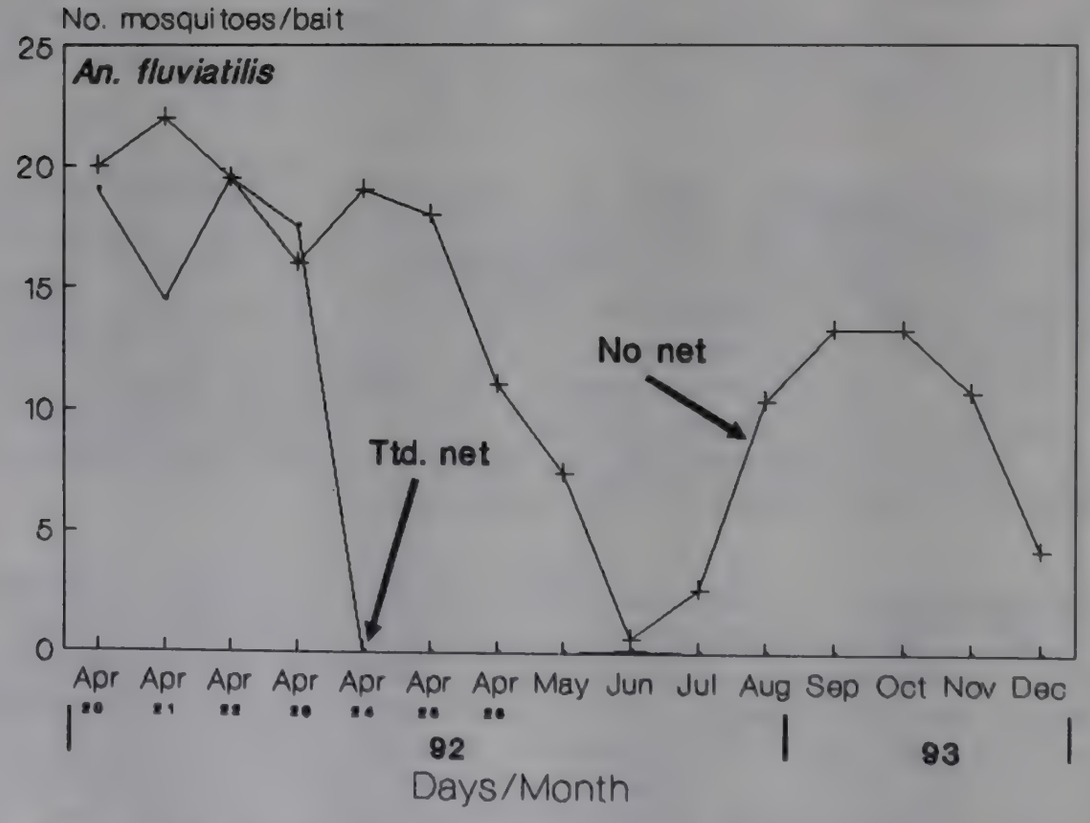


Fig. 6: Rourkela: Impact of cyfluthrin treated bednets on the biting of An. fluviatilis on humans in mining settlements (data are average of one indoor and one outdoor human bait)

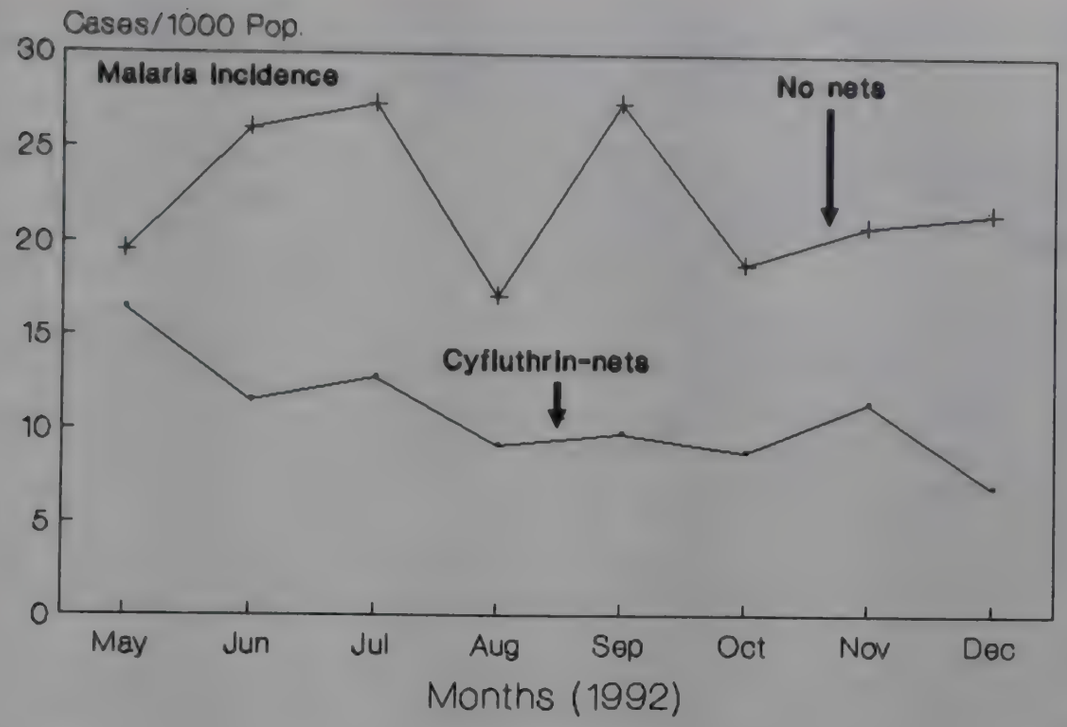


Fig. 7a: Rourkela: Impact of cyfluthrin treated bednets on malaria incidence in mining settlements

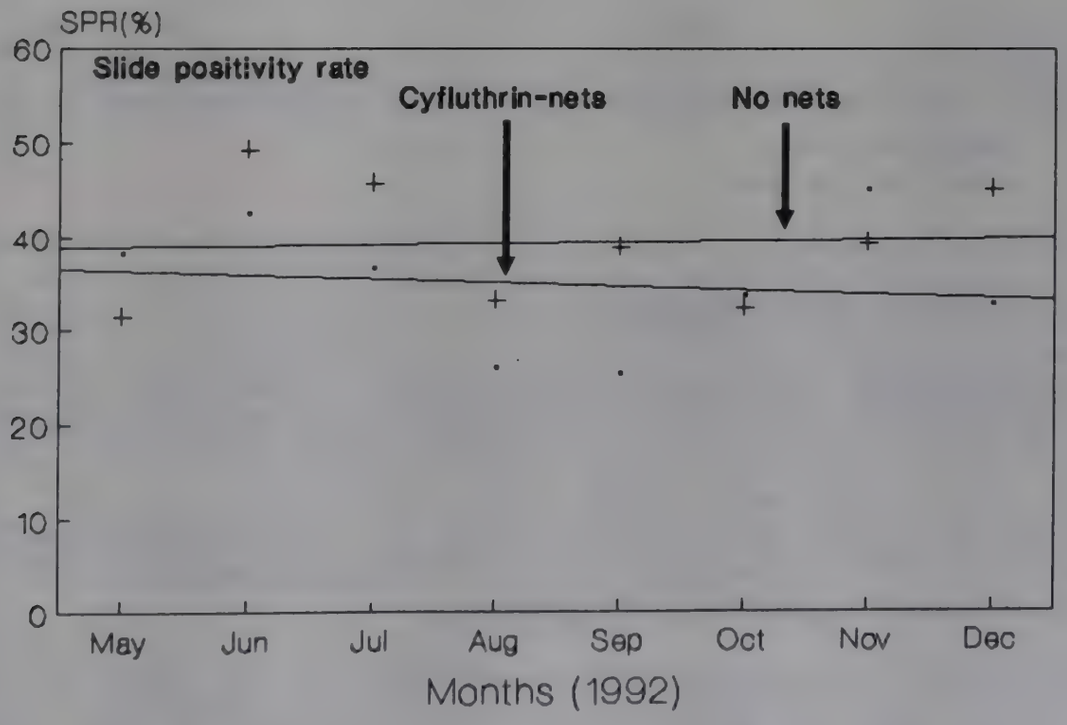


Fig. 7b: Rourkela: Impact of cyfluthrin treated bednets on slide positivity rate in mining settlements

TABLE 3 : ROURKELA : IMPACT OF CYFLUTHRIN TREATED BEDNETS ON INDOOR ADMISSIONS DUE TO MALARIA IN MINE HOSPITALS AT TENSA AND KALTA.

Months	All fever cases		Malaria cases	
	1991 *	1992 **	1991	1992
Apr	144	75	57	39
May	131	60	110	51
Jun	86	53	64	44
Jul	66	50	75	48
Aug	123	54	72	43
Sep	51	47	47	24
Oct	81	32	108	40
Nov	72	52	66	28
Total	724	423	599	317
% reduction in 1992		(41.6)		(47.1)

* Baseline year
** Intervention year

OTHER PARASITOLOGICAL STUDIES:

Renal involvement in quartan malaria : Earlier studies in Africa indicated that the presence of renal syndrome is associated with P. malariae infections in children. Since P. malariae was recorded in our area, a study on the possible association of renal malfunction with P. malariae infections was initiated in 1990 in collaboration with Biochemistry Division of the Ispat General Hospital, Rourkela.

Preliminary screening indicated that in 44 out of 70 cases (62.8%) the ratio of urine protein to creatinine was more than 0.2. Of the 44 cases 39 (including 26 children) could be followed-up after one year of initial screening. Random blood and urine samples were collected from these patients. Blood samples were analysed for cholesterol, urea, creatinine, total protein and albumin, while urine samples were analysed for

creatinine and albumin. In all the patients the above mentioned blood parameters were within normal ranges. However, in two patients urine showed hyperalbuminea condition but creatinine was within normal range. Clinically these two patients were normal. The cause of urine hyperalbuminea is not understood and a single parameter abnormality is not sufficient to prove conclusively any renal malfunction. This study showed that quartan malaria does not cause nephrotic syndrome in this area.

In vivo sensitivity of SDX-PYR to P. falciparum : Earlier in vitro study indicated presence of sulfadoxine-Pyrimethamine (SDX-PYR) resistance in P. falciparum in the rural area adjoining Rourkela town. Therefore, an extended in vivo study was done in June and July 1992 (Table 4). Out of 54 cases selected 33 were successfully followed-up. Twenty eight isolates were found sensitive where as 5 isolates showed RI level of resistance against SDX-PYR. This is the first report in Orissa.

Malaria clinic : In the malaria clinic being run at the field station premises, 2717 fever patients reported for malaria examinations (Table 5), either referred by local practitioners or directly. Out of these 484 (17.8%) were found malaria positive. There were 200 P. vivax cases, 280 P. falciparum cases, 4 P. malariae cases and three microfilariae cases. All positive cases were given treatment for malaria, while acute/severe cases were referred to the nearby Government Hospital.

STUDY ON THE MOSQUITO BREEDING ASSOCIATED WITH RICE AGRO-ECOSYSTEM:

The study was launched in July 1992. Three ecosystems were selected viz. forest (villages Burkera and Pograbahal), irrigated broken-forest (village Balanda) and peri-urban area of Rourkela town. Samples of immatures were collected on weekly basis from paddy fields and the associated breeding habitats. Other physico-chemical factors were also monitored. Although the

TABLE 4 : ROURKELA : IN VIVO SENSITIVITY OF P. falciparum to SDX-PYR

Period	Cases studied	Followed-up	No. sensitive	No. Resistant			
				RI	RII	RIII	Total
Jun - Jul 1992	54	33	28	5	0	0	5

TABLE 5 : ROURKELA : CASE DETECTION AND TREATMENT OF MALARIA CLINIC

Month	BSE	POS	Pv	Pf	Pm	Mf	SPR(%)	Pf(%)
Jan	218	34	15	19	0	0	15.59	55.88
Feb	110	14	11	3	0	0	12.72	21.42
Mar	186	25	15	10	0	0	13.44	40.00
Apr	190	43	18	24	1	0	22.63	55.81
May	186	31	17	14	0	0	16.66	45.16
Jun	184	44	27	17	0	1	23.91	38.63
Jul	251	45	16	28	1	0	17.92	62.22
Aug	335	27	17	10	0	0	8.05	37.03
Sep	293	34	17	16	1	0	11.6	47.05
Oct	274	55	18	37	0	0	20.07	67.27
Nov	246	54	13	41	0	1	21.95	75.92
Dec	244	78	16	61	1	1	31.96	78.2
Total	2717	484	200	280	4	3	17.81	57.85

study is in progress, details of mosquito breeding have been given in Table 6. Sixteen anopheline and 15 culicine species were recorded from paddy fields. These included vectors of malaria viz. An. culicifacies, An. annularis, An. fluviatilis; JE viz. Cx bitaeniorhynchus and Cx. tritaeniorhynchus and of filariasis viz. Cx. quinquefasciatus. Further study is in progress.

TRANSFER OF TECHNOLOGY:

After the completion of bioenvironmental control study in Bisra block in 1991, efforts are underway towards transfer of technology so that the integrated methods are absorbed in the malaria control programme. During the period under report, a team visited Balasore municipality and after survey of the urban area suggested methods of mosquito control. On the request of

Bhadrak municipality Gambusia fishes were sent for biological control. Gambusia and Tilapia fishes were also sent to Gomardih Dolomite Mine (TISCO) in District Sundergarh for biological control.

TABLE 6 : ROURKELA : MOSQUITO SPECIES BREEDING IN PADDY FIELDS

Sl. No.	Species	Percentage composition	Percentage occurrence *
1.	An. aconitus	0.1	0.2
2.	An. annularis	5.2	8.7
3.	An. barbirostris	2.2	4.6
4.	An. culicifacies	1.6	2.9
5.	An. fluviatilis	1.8	5.3
6.	An. jamesii	0.6	1.0
7.	An. maculatus	0.2	0.2
8.	An. nigerrimus	58.4	48.3
9.	An. pallidus	12.0	13.8
10.	An. ramsayi	0.6	1.2
11.	An. splendidus	0.6	1.2
12.	An. subpictus	6.6	8.3
13.	An. tessellatus	1.4	1.5
14.	An. theobaldi	1.0	1.9
15.	An. vagus	7.5	10.4
16.	An. varuna	0.1	0.2
Total no. of adult anophelines emerged		1631	-
17.	Cx. bitaeniorhynchus	3.8	9.5
18.	Cx. brevipalpis	1.3	4.1
19.	Cx. cornutus	10.2	22.1
20.	Cx. (Lu) fuscanus	1.4	5.6
21.	Cx. gelidus	1.8	4.4
22.	Cx. mimulus	2.2	5.8
23.	Cx. nigropunctatus	2.6	3.6
24.	Cx. pallidothorax	2.8	3.9
25.	Cx. quinquefasciatus	3.0	3.6
26.	Cx. tenuipalpis	3.3	10.4
27.	Cx. tritaeniorhynchus	32.6	47.1
28.	Cx. vishnui	0.7	1.5
29.	Ae. pipersalatus	0.0	2.2
30.	Ae. vittatus	0.0	2.2
Total no. of adult culicines emerged		3850	-

* Total no. of samples collected = 42

The Area Development Programme (Govt. of Orissa) funded by British Council Division (UK) is conducting a bednet trial in Phulbani district with full technical support of Malaria Research Centre. Baseline work has already been started. Requests are pouring in from various mines on Orissa-Bihar border for extended know-how of impregnated bednets for malaria control. Thus, efforts are being made to provide technical information required by the prospective user agencies.

We have also participated in three training programmes organised by Area Development Programme. Thus, the field station is making all round efforts to strengthen the malaria control programme through transfer of relevant information and technology developed.

(xi) PANJIM, GOA

Malaria Research Centre introduced bioenvironmental control measures from July 1989. The baseline studies revealed that An. stephensi was breeding prolifically in various habitats like wells, curing water, masonry tanks, overhead tanks, sumps, fountains, intradomestic barrels, etc. Weather conditions also favoured perennial vector breeding and transmission of malaria. Various other factors that contributed to high malaria endemicity were,negligible cattle population, randomly located construction sites throughout the city with labour hutment, rains, P. falciparum resistance to chloroquine and multiple relapses of P. vivax.

An. stephensi seems to be a recent phenomenon in Goa as it has been found to have a very limited distribution in the state. Upto 1991, it was found confined to Panaji and surrounding areas such as Taleigao, Betim, Porvorim, Alto St. cruz, St. cruz and Bombolim plateau. But in 1992, it has invaded Corlim, Britona, Sridaon, Goa Velha besides Khorlim area of Mapusa town. It has not been reported from Vasco and Margaon, the other two main cities of Goa, which have conditions similar to Panaji but due to the absence of vector indigenous transmission is absent.

Man hour densities (MHD) of mosquitoes collected from Panaji revealed that overall mosquito densities in the control area were comparatively high in almost all months as compared to experimental area in 1992. It was particularly so in the case of anophelines whereas, in case of culicines, the densities of Culex quinquefasciatus were higher in the experimental area as compared to control area. This was due to the overflowing septic tanks in Campal, Miramar areas. An. stephensi was collected in very low densities in both experimental and control areas. In experimental area it was collected in 9 months whereas in control the species was collected in 5 months from March to July although in comparatively higher densities than experimental area. The bulk of the anophelines were contributed by Anopheles subpictus in both the areas. The adult collection using CDC traps revealed that mean per trap densities of An. stephensi varied from 0 to 0.66 and 309 trap nights spread over 16 months yielded only 71 An. stephensi with an overall per trap density of 0.23. In control area (Bombolim), 103 trap nights yielded 220 An. stephensi adults with a per trap density of 2.13. When separated for the human dwellings and cattlesheds, it was observed that per trap density of 0.76 in human dwellings was higher than 0.3 in the cattlesheds.

All night collections were done from 1800 to 0600 hrs to determine the biting rhythm of An. stephensi on a human bait (Fig. 1). Although in 75 bait collections spread over 14 months

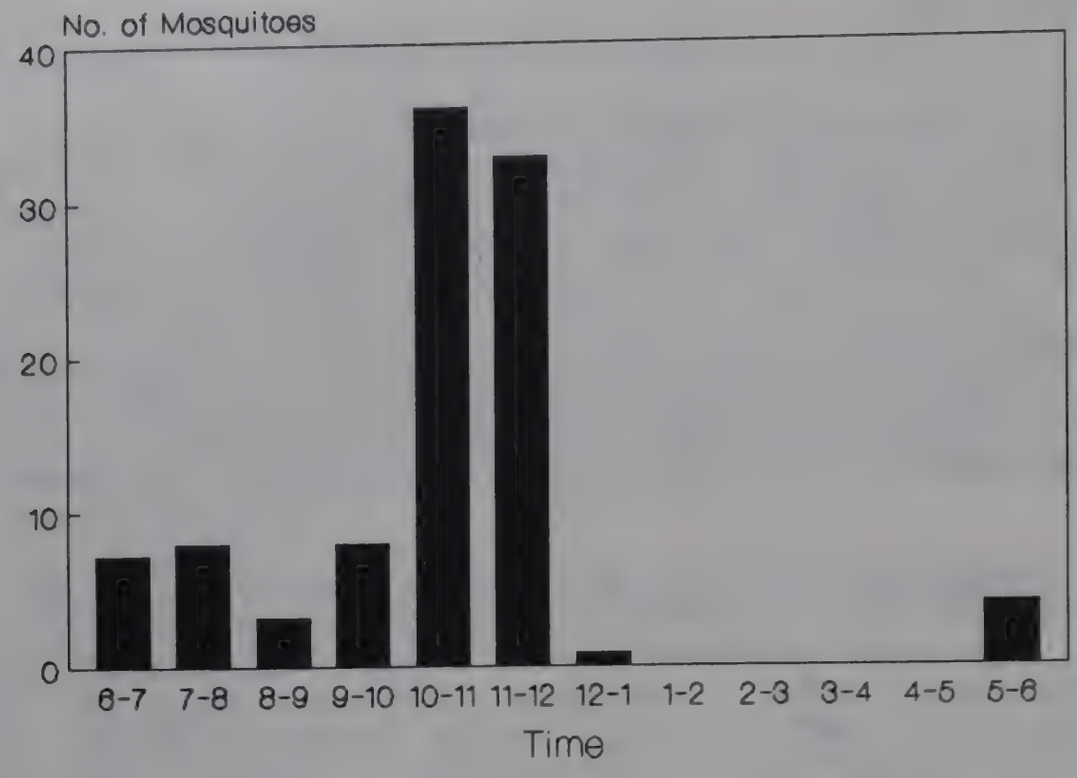
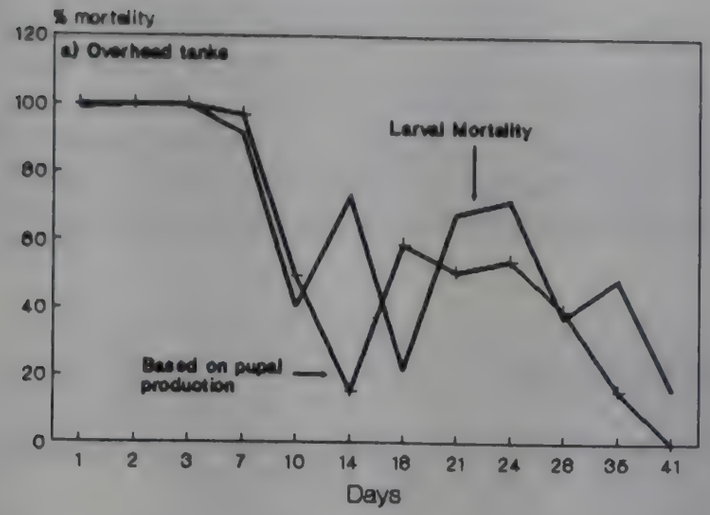
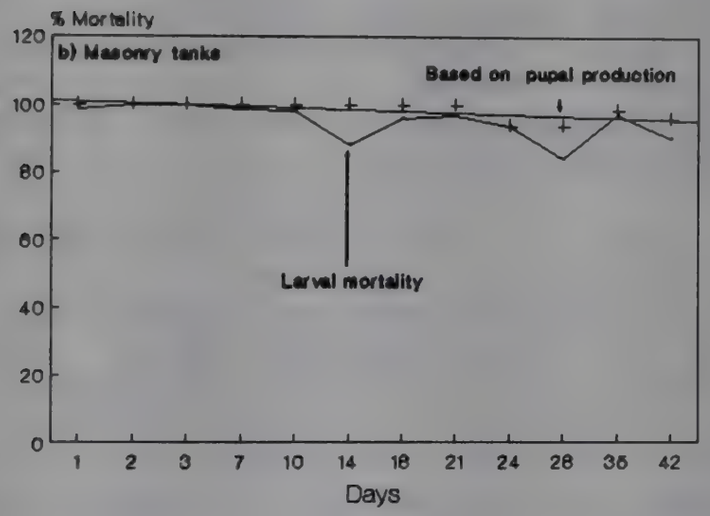


Fig. 1: Goa: Man biting rhythm of An. stephensi

only 125 An. stephensi females could be collected, yet there was a discrete blood feeding pattern. It can be seen from Fig. 1 that most of the biting took place before 1.00 clock in the midnight and feeding was maximum between 2200 to 2400 hrs as bulk of the mosquitoes were collected during these hours. No biting was observed between 0100 to 0500 hrs although little biting resumed at 0500 hr. On the other hand, the man biting rate (MBR) of 7.5% and 2.86% was observed in June and July 1991, whereas it was 1.66% and 3.0% in March and April 1992 respectively.

The larvicidal activity of Bacillus thuringiensis H-14 (Bactoculicide) was evaluated against An. stephensi larvae in curing waters, masonry tanks and discarded overhead tanks @ 1 gm/sq mt surface area. In curing waters a near total mortality was observed within 24 hours and it continued upto day 7. On day 10 however, there was a marginal reduction in mortality to 87.25% which improved on day 14 and day 18 and then on day 21 onwards the re-appearance of immatures was observed. On the other hand no pupal production was observed upto day 21 (Fig. 2). Thus it can be safely concluded that Bactoculicidae was efficacious upto day 21 in curing waters. On the other hand in masonry tanks 98.6% mortality was observed on day 1 and it was cent per cent upto day 3rd whereupon it reduced to 98.6% and 97.9% on day 7 and 10 respectively. But there was a good control upto day 42. There was no pupal production upto day 18th and it remained very low upto day 42. In rejected overhead tanks, the picture was





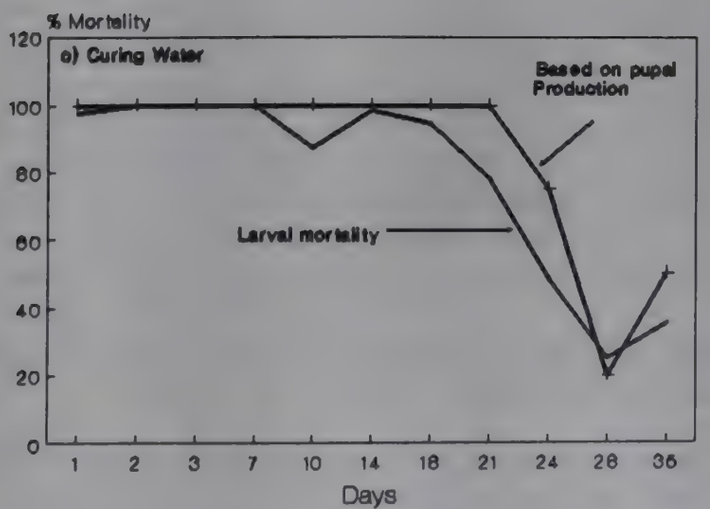


Fig. 2: Goa: Evaluation of B. thuringiensis, H-14 (Bacto-culicidae) applied @ 1gm/sq mt against An. stephensi

different, the larval mortality was 100% on day 2 and a good control could be achieved only upto day 7,thereafter the impact was lost as is evident from the re-appearance of the larvae. Based on pupal production, it can be concluded that in overhead tanks a good control could be achieved only upto 7 days and a weekly application of Bactoculicidae at a dose of 1 gm/sq mt is necessary.

MOSQUITO IMMATURES HABITATS:

The habitatwise status of mosquito breeding is briefly discussed below for the important habitats.

Wells: There are 533 used wells in the city of Panjim. These wells were monitored for mosquito breeding weekly. Nineteen species of mosquitoes were found breeding in wells. In 1990, 14342 checks were done. Mosquito immatures were encountered on 462 (3.27%) occasions. Of these, 105 contained anopheline and 369 culicine breeding. Eighty one out of 105 samples showed An. stephensi larvae accounting to 0.56%.

In 1991, a total of 14,284 checkings were done by drawing water samples. Immatures of mosquitoes were found in 205 i.e. 1.4% of which, 67 (0.46%) belonged to anophelines and 148 (1.03%) to culicines. It is noteworthy that out of total anophelines collected only 1 sample was that of An. stephensi.

In 1992, out of 9456 wells surveyed, 138 (1.4%) had mosquito immatures, of these 67 belonged to anophelines and 87 to culicines. An. stephensi emerged from 12 samples accounting for a mere 0.12% of the total surveyed.

It will be worthwhile to mention that in all these wells larvivorous fishes Aplocheilus blockii, Gambusia affinis, Lebistes reticulatus, and Rasbora daniconius were introduced @ 20 fishes/well and only I and II instar larvae were encountered. The III and IV instar and pupae were never detected. Although peak positivity of mosquito immatures was detected in January, March and July in 1990, 1991 and 1992 respectively, yet An. stephensi peak values were observed in June, December and January respectively. It is also clear that breeding positivity of wells in general and that of An. stephensi in particular, declined in 1991 and 1992 as compared to 1990.

Fountains: In Panaji there are 20 ornamental fountains and 2 natural springs called Mala-Zari and Boc-de-vaca. In 1990, 602 checkings of the fountain waters for mosquito breeding revealed that 49 i.e. 8.13% were harbouring mosquito immatures. Of these 30 samples yielded anopheline larvae and 23 belonging to culicines. Interestingly, all but one anopheline samples yielded

An. stephensi adults. The percent positivity of fountains for An. stephensi ranged from 1.36% to 11.4%.

In 1991, a total of 916 checkings revealed mosquito breeding in 146 (15.93%) sample. Seventy six were that of anophelines and 112 belonged to culicines and only 27 (2.94%) were that of An. stephensi. No An. stephensi positivity was detected in fountains after July 1991.

In 1992, out of 861 occasions, when fountains were checked, 64 contained mosquito immatures. Out of these, 31 (3.6%) had immatures of anophelines and 40 (4.64%) culicines. Out of 31 anopheline samples, 3 were that of An. stephensi.

Like wells, fountains were also covered with larvivorous fishes and only I and II instar larvae were detected in them. The mosquito breeding in fountains fluctuated widely in different months. Good control of An. stephensi breeding in fountains was observed in pre-monsoon period.

Masonry tanks: In 1990, a total of 5009 tanks were checked for the breeding of immatures, 398 (7.94%), of these were positive. 148 i.e. 2.95% contained anophelines of which 120 samples yielded An. stephensi upon adult emergence.

In 1991, as many as 10,709 samples were checked of which 627 i.e. 5.85% were found positive. 235 i.e. 2.19% of the masonry tanks were harbouring anopheline breeding of which 52 (i.e. 0.48%) were containing An. stephensi immatures.

In 1992, a total of 15,205 masonry tanks were sampled. Of these, 623 (4.09%) were found positive for immatures and 84 (0.55%) positive for An. stephensi accountng for 0.55%. The peak positivity of the latter species was observed in June when 14 habitats were found positive.

The peak positivity of An. stephensi in masonry tanks was observed in June in 1990 and 1992. Whereas, it was in April in 1991. Although in 1990 An. stephensi positivity peaked to 6% in June, it gradually declined and remained below 1% in 1991 and 1992. It may be mentioned that larvivorous fishes were stocked in masonry tanks during these years for the control of breeding.

Overhead tanks: Ten mosquito species were found breeding in the overhead tanks. A total of 22,833 OHTs were surveyed out of which 390 were positive. Of these 257 (1.1%) contained anopheline and 148 (0.6%) culicines immatures respectively. 253 (1.1%) samples of anophelines belonged to An. stephensi. The positivity of OHTs ranged from 0.09% in November to 4.02% in June 1990.

In 1991, 45,217 samples were drawn from the overhead tanks which yielded 293 (0.6%) samples of immatures. Of these only 92

(0.18%) belonged to An. stephensi. In 1992, 34,950 total samplings were done yielding 315 positive samples, 81 samples were that of An. stephensi accounting for 0.23% of the total surveyed. The peak positivity in overhead tanks was found in June 1990 and 1991 and in July 1992. Although peak habitat positivity for An. stephensi was above 4% in 1990 in the month of June, it was below 2% in 1991 and 1992.

Ground water tanks (Sumps): In 1990, a total of 7845 sumps were checked, out of these 167 (2.12%) were found positive and only 79 had anopheline breeding. Forty eight samples from 79 were that of An. stephensi, the breeding index of which ranged from 0 to 1.4% in May 1990.

In 1991, a total of 17338 checkings of sumps showed 1.92% positivity for all mosquito species and 0.19% for An. stephensi immatures, when 34 tanks were found positive for this species. In 1992, 17,074 samplings revealed that 642 sumps were harbouring immatures of mosquitoes accounting for 3.76%. Of these, only 29 (0.16%) had immatures of An. stephensi. The peak positivity of sumps (1.4%) was observed in May 1990, in July 1991 (0.05%) and in February 1992 (0.34%). After attaining a peak positivity of 1.4% in 1990 the positivity of sumps for An. stephensi remained below 1% in 1991 and 1992.

Barrels and Tins: Sixteen species of mosquitoes emerged from barrels and tins. Out of 6839 checked in 1990 443 i.e. 6.5% habitats were containing mosquito immatures. All the 53 anopheline samples yielded An. stephensi. The positivity index ranged from 0 to 5.41% in 1990. In 1991, a total of 20,559 barrels and tins were checked, 1004 i.e. 4.88% were found positive for mosquito immatures. Only 33 samples were of anophelines, of which 25 i.e. a mere 0.12% belonged to An. stephensi. In 1992, 27,876 barrels and tins were checked throughout the year and 915 (3.28%) had mosquito immatures. Only 6 were found to have An. stephensi. Peak positivity of 5.41% for An. stephensi was observed in July 1990 whereas, it was 0.32% in June in 1991. In 1992, the peak was a mere 0.09% in October. Thus it was amply clear that An. stephensi breeding positivity which was 5.41% in 1990 declined sharply after mid 1990 and remained very low throughout 1991 and 1992.

Curing water: Twenty two species of mosquitoes were detected from curing water. In 1990, during surveys, 4872 curing waters were checked, out of which 322 (6.6%) were found positive. One hundred and nineteen i.e. 2.44% had An. stephensi breeding. The breeding positivity of this species ranged from 0.6 to 9.0%.

In 1991, a total of 15,493 checkings of curing water stagnations were done. Out of these, 1729 (i.e. 11.15%) were positive for immatures of mosquitoes. Of these, 229 (i.e. 1.47%)

positive samples were of An. stephensi species. In 1992, the number of curing water samplings rose to 22,606 with 1976 (8.74%) positive out of which 196 had An. stephensi, immatures i.e. in 0.86% habitats.

The peak positivity of curing water for An. stephensi was to the tune of 9% in June 1990 but declined as curing water breeding did not cross 3% in any of the months of 1991 and 1992.

Tyres: The breeding index of tyres was generally very high as is revealed by 452 (44.4%) positive samples out or 1018 checked. Majority of the immatures belonged to culicines and only 40 (3.92%) contained anophelines and all of them were that of An. stephensi. The peak breeding index of this species touched 8.9% in July 1990.

In 1991, 1637 tyres were checked with a breeding index of 20.5% and An. stephensi was only detected in one tyre in July 1991. In 1992 An. stephensi breeding was found only in 2 tyres out of 2619 checked.

This clearly shows that although tyres contributed effectively to An. stephensi in 1990 they hardly supported this species in 1991 and 1992. The overall mosquito breeding also declined considerably in these years as compared to 1990.

Intradomestic containers: A total of 1928 intradomestic containers were checked of which 325 contained mosquito breeding accounting to 16.8% but only 7 i.e. 0.36% had immatures of An. stephensi.

In 1991, a total of 12,771 containers were checked and 640 of them i.e., 5.01% had mosquito immatures. Only one container in January was found having An. stephensi breeding. In 1992, although the number of intradomestic containers checked rose to 26,495 only 4 containers supported An. stephensi breeding. Thus it can be concluded that coconut shells, small bottles etc. are generally not preferred by An. stephensi for breeding. Although a good proportion of them may support the breeding of other mosquito species.

INTERVENTION STRATEGIES:

Fish Introduction: 3,20,154 larvivorous fishes belonging to 5 species were introduced in a variety of habitats for the control of mosquito breeding (Table 1). The predominant species used was local fish Aplocheilus blockii, a top minnow. A total of 2,99,532 fishes of this species were introduced in 6881 habitats including wells (2688), masonry tanks (2603), ground water tanks (704),

TABLE 1: GOA: HABITATWISE FISH INTRODUCTION DATA FROM JANUARY 1990 TO DECEMBER 1992

Breeding Habitats	*A. blockii*		*G. affinis*		*P. reticulata*		*R. daniconius*		*O. mossambica*		*P. ticto*	
	No. Habitat	No. of Fishes	No. Habitat	No. of Fishes	No. Habitat	No. of Fishes	No. Habitat	No. of Fishes	No. Habitat	No. of Fishes	No. Habitat	No. of Fishes
Wells	2688	120311	31	740	-	-	65	511	-	-	2	60
Masonry tanks	2603	129524	-	-	39	2415	31	415	8	33	7	310
Ground water tank	704	23073	-	-	67	1925	-	-	7	115	-	-
Fountains	265	10538	18	1540	31	1890	-	-	3	13	-	-
OHT	437	8121	-	-	-	-	-	-	-	-	-	-
Rainwater collection	184	7985	-	-	-	-	-	-	-	-	-	-
Pond	-	-	29	2470	-	-	-	-	-	-	3	75
Drain	-	-	-	-	98	8090	-	-	-	-	-	-
Total	6881	299552 (93.5%)	78	4750 (1.48%)	235	14320 (4.47%)	96	926 (0.28%)	18	161 (0.05%)	12	445 (0.13%)

fountains (265), overhead tanks 9437) and rain water collection (184). Gambusia affinis fishes (4750) were introduced in 31 wells, 18 fountains and 29 ponds. Poecilia reticulata was found very effective in drains and initially 8090 fishes were introduced in 98 drains. In some of the drains this fish has multiplied extensively but it is difficult to estimate its number. Besides, 2415 Poecilia reticulata fishes were also introduced in 39 masonry tanks, 1925 in 67 sumps and 1890 in 31 fountains. Rasbora daniconius has been found to be very effective (Annual report 1991), but low breeding potential is its limitation. Sixty five wells were covered with 511 Rasboras, whereas 415 were introduced in 31 masonry tanks. Besides these fishes 161 Oreochromis mossambica were introduced in 12 habitats and 445 Puntius ticto were introduced in 12 habitats.

Biocide: Biolarvicides Bacillus thuringiensis (bactoculicidae) and Bacillus sphaericus (spherix) were applied @ 1gm/sq m in the anopheline and culicine habitats respectively. Biolarvicides controlled the breeding of mosquitoes between 24 to 48 hours. The results of field testing of biolarvicides are given in the Fig. 2. It is, however, mentioned that biolarvicides were applied only in the positive habitats. B. thuringiensis was applied on 1768.7 sq m surface area of water containing mosquito immatures in masonry tanks, ground water tanks, curing water, rain water collection on terraces and drains. Whereas, Bacillus sphaericus was applied on 2569.5 sq m water surface area in all these habitats.

Netting and source reduction: Netting of mosquito immatures served a useful purpose for the control of immatures particularly in overhead tanks, masonry tanks and deep curing water. Nettings of the mosquito immatures was a regular practice and a total of 8201 nettings were done in positive breeding habitats from 1990-92. These included 998 in overhead tanks, 1648 in masonry tanks, 1269 in sumps, 259 in fountains and 4027 in the curing waters.

Source reduction by overturning/emptying of 5168 habitats was done from 1990 to 1992 which included 1661 intradomestic containers, 2363 barrels and tins and 1144 tyres.

HEALTH EDUCATION:

At the time of launching of bioenvironmental control of malaria in Panaji, it was observed that people had many myths about the disease. Often people linked garbage with mosquito proliferation and some believed that the malaria parasite were bacteria or viruses and the disease was contagious. Therefore, need for a sound health education campaign was realized in the beginning itself. Health education was aimed at creating a critical awareness in people about all the aspects of malaria

TABLE 2: GOA : HEALTH ACTIVITIES IN PANAJI AND THEIR MAGNITUDE FROM 1989 - 92

Sl. No.	Health education activity	Area/People	No. of events	No. of people attended
1.	Exibition-cum-health camps	(i) Residential colonies	42	14,945
		(ii) Construction sites	16	1,100
		(iii) Colleges	5	800
		(iv) Schools	28	12,247
2.	Door-to-door visits	(i) Residential colonies	752	816
		(ii) Construction hutments (households)	1059	2,193
3.	Video shows	(i) Colonies	42	3,540
		(ii) Construction	11	760
		(iii) Colleges	6	306
		(iv) Schools	7	2,980
4.	Pamphlets	(i) Residential colonies	4	18,100
5.	Lectures		56	1,135
6.	Visit of people to laboratories		21	435
7.	Training Programmes	(i) Nursing students	7	103
		(ii) College students (NSS)	10	273
		(iii) MPWs	2	138
		(iv) Lab. Technicians	5	31
		(v) Sanitary inspectors	5	32
		(vi) Boy scouts inspectors	1	305
		(vii) JRC counsellors	5	395
8.	Press tour, press conferences and discussions		125	960
9.	Workshops	Builders/contractors/ Engineers/Health authorities etc.	2	105
10.	Press information and educative articles		123	Not Known
11.	AIR		1	Not Known

and also to prepare them to undertake mosquito intervention in their ambient in order to harness their co-operation in the programme.

From the beginning of 1990 people of Goa were involved in malaria control. These included students, public in general, practitioners of medicine (individually and through IMA branches), engineers, contractors, builders, labourers and many government officials from various departments. This was achieved by a continuous effort wherein the health education wing of the field station arranged a series of lectures, state level seminars (in collaboration with Goa branch of Indian Red Cross Society), exhibitions/health camps, workshops, video shows, training programmes, door-to-door visits, meetings and also through informative press reports (Table 2).

Table 3 gives details of participation by health and non-health sectors in malaria control. Sixteen agencies participated in malaria control. In 1992, a major breakthrough towards involving the student community was achieved when the Junior Red Cross, Board of studies after detailed deliberations agreed to include various aspects of malaria in JRC curriculum for standards VIII, IX and X (Table 4), in Goa. To train the JRC counsellors from all over Goa a state level training workshop-cum-seminar was organized in August 1992, which was attended by 142 counsellors. Subsequently, 7 more seminars cum workshops were organized at different places in Goa. This programme is expected to play a major role towards the preparation of the youth to face the challenge posed by malaria.

The civic bodies have also started showing keen interest in the bioenvironmental programme and health education on malaria. In the middle of 1992 Bicholim Municipal Council requested the Centre to conduct a mosquito survey in the town and subsequently the Council arranged a seminar-cum-exhibition on malaria for the benefit of the community. In November 1992, Mapusa Municipal Council initiated a programme under centrally sponsored scheme, 'Basic services for the urban poor' and the theme chosen was 'Prevention of Malaria'. Council sought the help of MRC field station to train 100 volunteers-cum-community workers. The technical assistance was rendered and the exhibition was conducted by the MRC field station. The Municipality has also adopted model bye-laws in consultation with MRC field station in order to reduce mosquito breeding potential in various habitats such as ponds, drains, septic tanks and overhead tanks.

While working with the school and college students, it has been felt that these groups have high level of motivation and are most receptive to new ideas. Moreover, they can spare time for dissemination of health education on malaria. These groups have been actively involved from 1989 to 1992 in training

TABLE 3: GOA: INTERSECTORAL COOPERATION RENDERED BY VARIOUS INSTITUTIONS

No.	Agency/Department Institution	Activity	Remarks
1.	Ministry for Urban Development, Goa	Constituted committee to propose amendments in municipal act of Goa including the prevention of mosquitogenic conditions	Draft of proposals for amendments is under preparation.
2.	Municipal Council Panaji, Goa	Provided free soil for earthwork for filling	Soil was extremely difficult to get, free of cost, in Panaji area.
3.	Municipal Council of Ponda and Madgao	Supplied 3050 larvivorous fishes for introduction in wells of Ponda & Madgao towns	The municipality officials showed keen interest in in the maintenance of stocks for supply of fishes.
4.	Public Works Deptt., Goa	Replacement of faulty overhead tanks with mosquito proof tanks	Six such overhead tanks were replaced. Lack of funds impeded the progress but this work has been resumed.
5.	National Malaria Eradication Programme, (NMEP), Goa	In cooperation with NMEP, a draft for amendment in public health act of Goa, Daman & Diu, was prepared and submitted to the Govt., of Goa	Draft accepted by by the Government in toto and awaits ratification by the Goa legislative assembly.
6.	Urban Health Centre, Panaji, Goa	Issued 221 notices to defaulters and abetters of mosquitogenic conditions	Health authorities now have taken a serious view of non-compliance
7.	Indian Medical Assoc., Goa	Many members of the association referred malaria cases for blood smear examination and treatment. They also sent slides for cross checking	This helped in correct treatment

Cont...

TABLE 3: GOA: INTERSECTORAL COOPERATION RENDERED BY VARIOUS INSTITUTIONS

(Contd.)

No.	Agency/Department Institution	Activity	Remarks
8.	Defence, Goa	Supplied larvivorous fishes for establishing multiplication ponds and used fishes in army establishments in Goa	5400 An. blockii P. reticulata R. daniconius were supplied for this purpose.
9.	Directorate of Education, Goa	A chapter on the bio-environmental control of malaria has been proposed for inclusion as a topic in environmental education	Board of studies had accepted the proposal in principle; subject matter is under preparation for various classes.
10.	Nirmala Institute of Education, Panaji, Goa	Lectures on bioenvironmental control of malaria to B.Ed. students have been organised on regular basis on the request of the Institute	Lectures were delivered to first batch of B.Ed. students. The students showed interest in disseminating this knowledge in schools.
11.	Colleges, Goa	218 volunteers in 13 batches were trained, they imparted health education on malaria to 4117 persons in schools, colleges, residential colonies and construction sites	Requires proper motivation and training.
12.	Schools,Goa	25 boy scouts imparted health education on the prevention of intradomestic breeding in 406 households	Motivation and training necessary.
13.	Department of Science,Technology & Environment, Goa	Organized three exhibitions on the National Environment Day 1989, 1990 and 1991	Large crowds attended, specially school children.
14.	Voluntary Agencies, Goa	Two voluntary agencies helped in organizing health exhibitions and camps in Panaji and outside	Very useful activity for motivating people.

Cont...

TABLE 3: GOA: INTERSECTORAL COOPERATION RENDERED BY VARIOUS INSTITUTIONS

(Contd.)

No.	Agency/Department Institution	Activity	Remarks
15.	Press, Goa	Published 123 articles and news items on malaria	Very useful in promoting, bio-environmental methods
16.	Construction Industry	Organzied 2 workshops for builders, contractors, architects, site supervisors and project engineers	The delegates took keen interest in various preventive measures suggested in the workshop and their implementation is already noticeable. The problem of malaria in the construction industry is now being given priority by these groups. eg. fixing of mosquito proof lids on OHTs and sumps, and encouragement of labourers for blood test for malaria in the event of fever. The expenditure on both the workshops was borne by the builders themselves

programmes, door-to-door health education and for arranging exhibitions in the housing societies.

Health education wing of the Centre, also concentrated on door-to-door dissemination of information on malaria in housing societies, flats, bungalows and labour hutments. It was observed that this method is particularly useful for the families of labourers as they showed very keen interest in the programmes. It was also noticed that many construction companies made changes in their work schedules to allow labourers to visit malaria exhibitions and health camps arranged at construction sites.

TABLE 4: GOA: NEW APPROVED JRC SYLLABUS ON MALARIA

Std. VIII

Malaria Control : 30 Marks

1) Life-cycle of mosquito

2) Breeding sites of mosquitoes

3) Symptoms of malaria

4) Causes of malaria

Std. IX

Malaria Control : 30 Marks

1) Differentiation between a malaria vector and filaria vector

2) Life-cycle of malaria parasites

3) Transmission of malaria parasites

4) Bioenvironmental control of malaria

Std. X

Malaria Control : 50 Marks

1) Biocontrol of malaria

2) Environmental modification and source reduction in malaria control

3) Treatment of malaria

Projects and Assignments:

Std. VIII - 20 Marks

Std. IX - 20 Marks

PARASITOLOGY:

The malaria incidence in Panaji in 1992 has been shown in Table 5. Only 7 and 6 cases were reported in the year 1984 and 1985 respectively, and all were P. vivax. In 1986, outbreak of malaria occurred in the month of May in Campal and Miramar areas of the city and a peak number of 167 cases were reported in July and the total number of cases touched to 352 with only 1 P. falciparum case. The API touched a figure of 8.18. The situation worsened further in 1987 with the recording of 4406 malaria cases throughout the city with an API of 102.43. The total Pf cases increased to 7. No case of Pf was recorded in July in 1987 although a total of 985 cases were registered by the NMEP. In 1988 the Pf incidence rose sharply to 242 accounting to 4.26% of the 5677 total cases detected with a further ascent of the API to 132.5 in that year. A sharp increase in the slide positivity rate (SPR) from 5.38% in 1986 to about 20% in both 1987 and 1988 was also noticed. In 1989 there was a reduction in the incidence to 3523 (API 82.0). However, the Pf cases further shot upto 520. Consequently, SfR and Pf proportion also increased significantly to 2.47% and 14.7% respectively. It may be mentioned that in June 1989 Malaria Research Centre, field station became operational and bioenvironmental measures were introduced and massive anti-vector surveillance operations were launched.

In 1990 there was a slight increase in the incidence to 3780 (API 88.03) cases with a further increase in the Pf incidence to 710 cases. The SfR and Pf proportion increased to 3.8% and 19.18%

TABLE 5: GOA: MALARIA PARASITOLOGICAL DATA OF PANAJI IN 1992

Month	BSE	Pos	Pv	Pf	Mix (Pv+Pf)	Pm	SPR	SfR	Pf%	MPI	BER
Jan	544	33	32	-	-	1	6.06	-	-	0.77	0.93
Feb	383	10	10	-	-	-	2.61	-	-	0.23	0.89
Mar	376	23	18	5	-	-	6.12	1.33	21.74	0.53	0.88
Apr	404	29	24	5	-	-	7.18	1.23	17.24	0.68	0.94
May	516	42	38	4	-	-	8.14	0.78	9.52	0.98	1.20
Jun	695	43	32	11	-	-	6.19	1.58	25.58	1.00	1.62
Jul	950	34	29	5	-	-	3.58	0.33	14.7	0.8	2.21
Aug	901	39	27	11	1	-	4.33	1.33	30.77	0.9	2.10
Sept	616	40	29	10	1	-	6.5	1.8	27.5	0.93	1.43
Oct	605	63	56	6	1	-	10.41	1.16	11.11	1.47	1.41
Nov	541	52	38	14	-	-	9.61	2.58	26.92	1.21	1.26
Dec	527	37	19	17	-	1	7.02	3.22	45.94	0.86	1.23
Total	7058	445	352	88	3	2	6.3	1.28	20.4	10.36	16.44

respectively. It may be mentioned here that with the introduction of slide examination facility at MRC laboratory, the results of slide examination became more reliable. On an average 20% discrepancy in the results was noticed initially with the NMEP laboratory and the positive cases reported at MRC parasitological wing were always higher. Further, mix infections of P. vivax and P. falciparum were detected from August onwards regularly. In 1991, there was a perceptible change in the scenario as malaria cases declined sharply after April and total incidence dropped to 1554 cases (API 36.21) with a significant decline in Pf incidence to just 63 cases. Consequently, SfR and Pf proportion also declined to 0.66% and 4.38% respectively. SPR also showed a slight reduction to 15.10%.

In 1992, the incidence fell steeply further to 445 cases only with an API of 10.36. However, there was a slight increase in the Pf cases to 88 over 63 reported in 1991 and it was for the first time that 2 cases of P. malariae were also detected amongst migrant labourers from Madhya Pradesh and Rajasthan.

Figures 3 and 7 clearly shows that malaria incidence declined after April 1991 as compared to 1990 and remained very low and more or less static in 1992. The slide positivity rate which shot up to 20% in 1986 declined to about 6% in 1992. Slide falciparum rate (SfR) which was increasing constantly upto

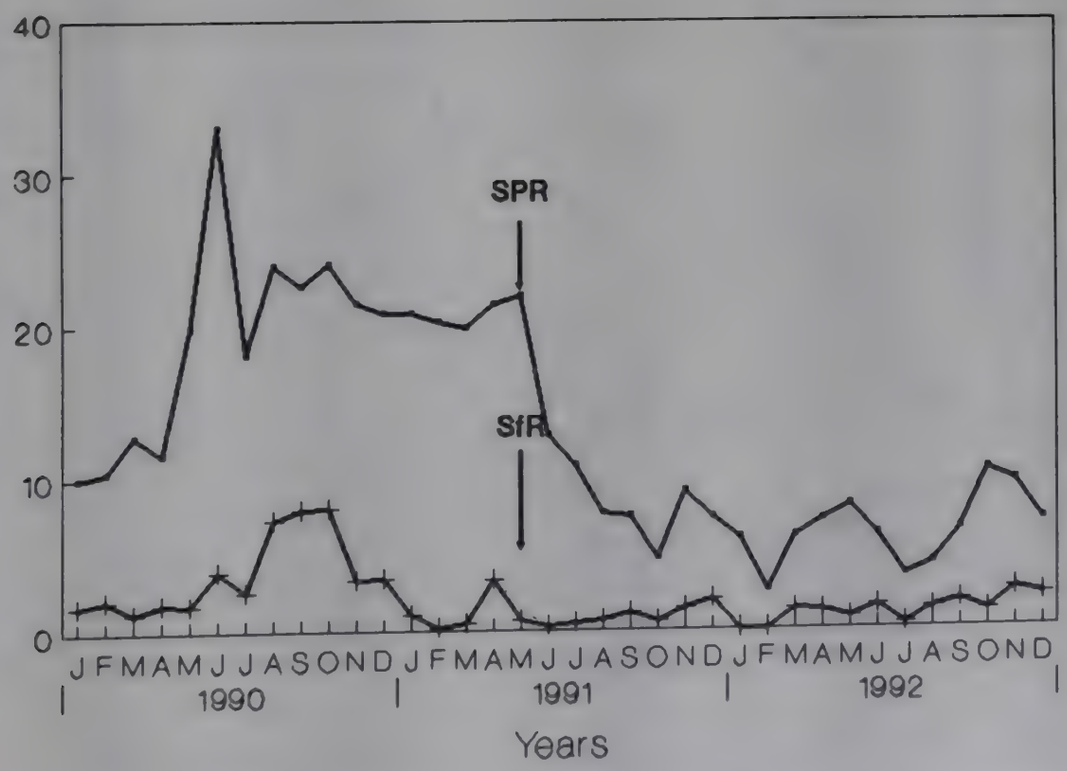


Fig. 3: Goa: Impact of intervention on malaria situation

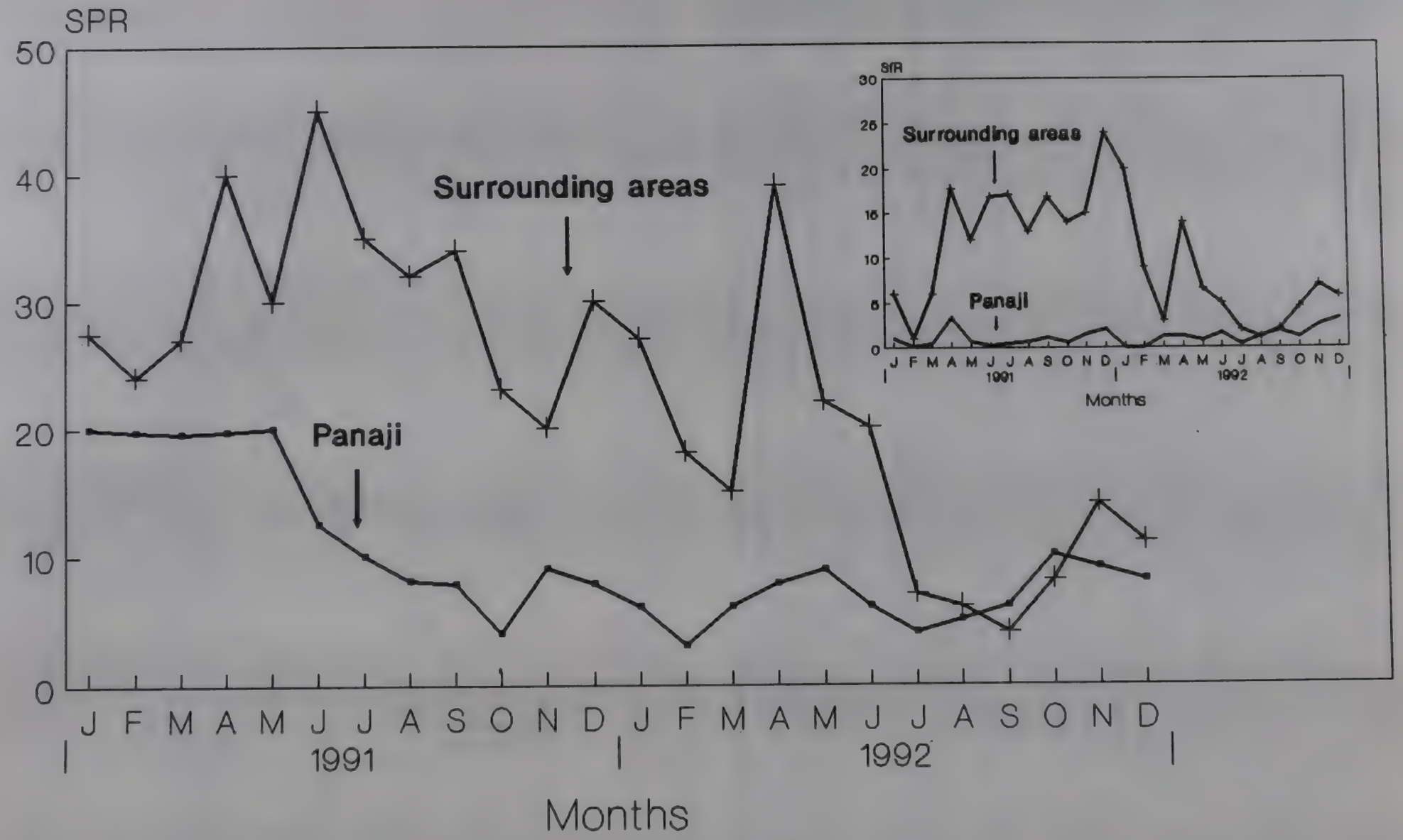


Fig. 4: Goa: Comparison of SPR and SfR (inset) between Panaji and surrounding areas in 1991 and 1992

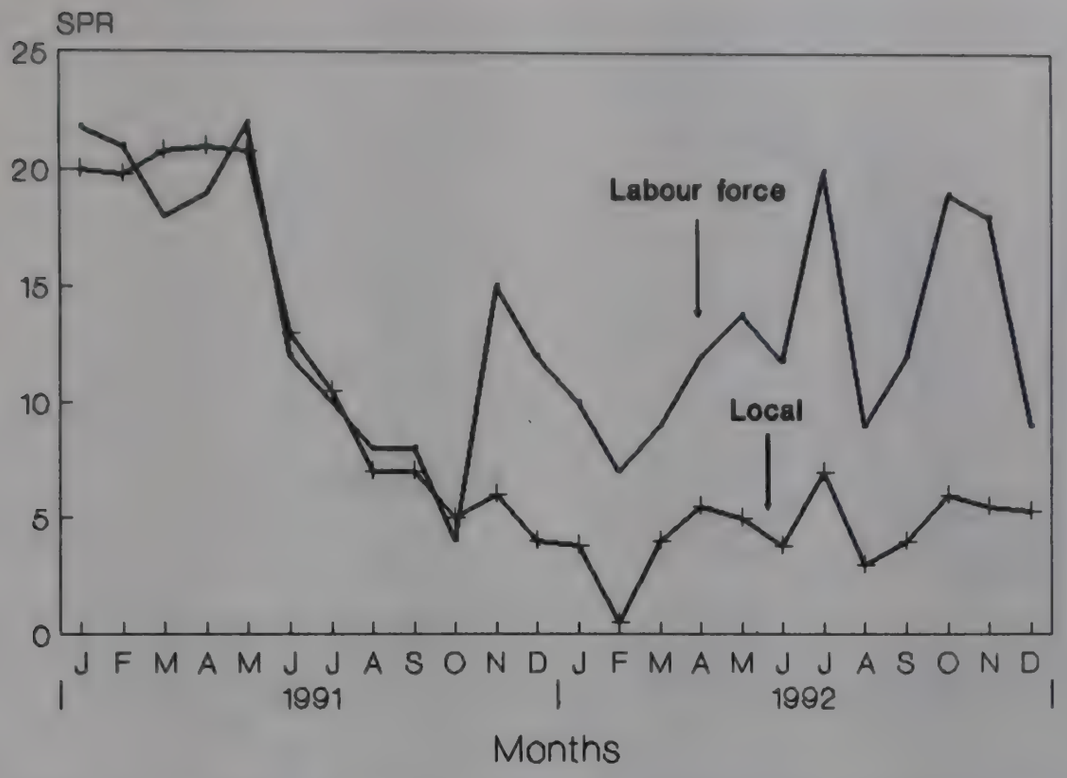


Fig. 5: Goa: Comparison of slide positivity rates between local and labour force in 1991 and 1992

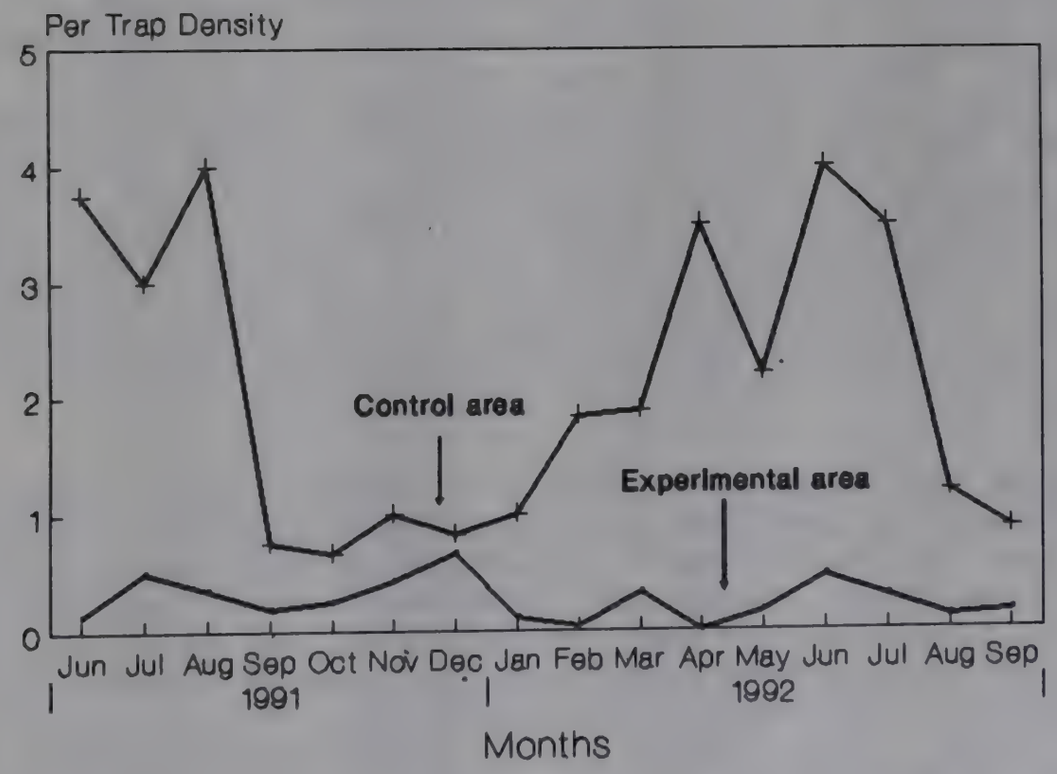


Fig. 6: Goa: Impact of intervention measures on <u>An. stephensi</u> adult CDC trap densities

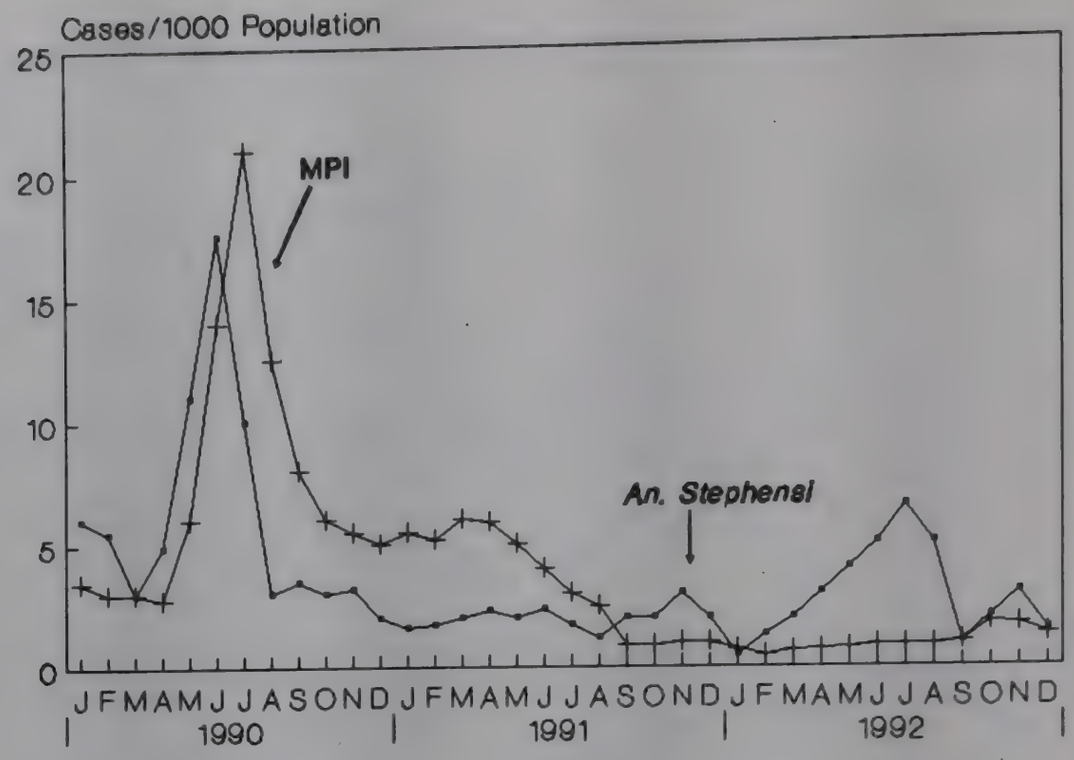


Fig. 7: Goa: Relationship between An. stephensi habitat positivity and MPI

1990 declined steeply in 1991 but there was a slight increase in the Pf incidence in 1992 as compared to 1991 although the total number of malaria cases reported were 445 in 1992 as compared to 1554 in 1991. When compared from 1990 to 1992 the SPR in Panaji remained much lower than surrounding areas except for September and October 1992 and it declined sharply in Panaji after May 1991 (Fig. 4). Similarly, the slide falciparum rate in the surrounding areas was much higher than Panaji, except for July to September 1992. It is interesting to note that in 1991 till the month of October the malaria slide positivity rate in local residents and labour force was more or less same but declined significantly after November 1991 in the local residents as compared to labour force (Fig. 5).

MISDIAGNOSIS OF MALARIA: Results of cross examination of 70 slides originally prepared and examined in private pathological laboratories in Panaji were presented in the annual report of 1990. These cross checks were continued and by the end of 1992 a total of 159 slides had been re-examined, of which 95 (59.7%) were correctly diagnosed upto parasite species level, 32 slides were labelled as malaria parasite positive, out of which one was false positive, 17 P. vivax and 14 P. falciparum (Table 6). 33 slides were misdiagnosed which included 11 false positive, 3 P. vivax instead of P. falciparum and 1 P. vivax but found P. malariae, 13 P. falciparum but had P. vivax, 1 declared P. falciparum and 4 declared P. vivax+P. falciparum and had P. vivax

TABLE 6: GOA: MISDIAGNOSIS OF MALARIA IN PRIVATE PATHOLOGICAL LABORATORIES IN PANJIM (UPDATED)

No. of slides re-examined for cross check	No. with correct identification of parasite species	No. labelled as malaria parasite positive but found				No. of slides misdiagnosis						
		1 Neg	2 Pv	3 Pf	Total	1	2	3	4	5	6	Total
159	95	1	17	14	32 (20.1%)	11	3	1	13	1	4	33 (20.7%)

1 - False +ve; 2 - declared Pv but found Pf; 3 - declared Pv by found Pm; 4 - Declared Pf but found Pv; 5 - declared Pf but found Pv+Pf; 6 - declared Pv+Pf but found Pv alone

TABLE 7: GOA: A COMPARISON OF MALARIA INFECTION IN INFANTS FROM 1990 TO 1992

Year	Status	B S C			Positive			Pf	IPR	IFR
		M	F	T	M	F	T			
1990	Local	16	11	27	1	3	4	1	14.8	3.7
(August onwards)	Labour	14	9	23	3	-	3	-	13.0	-
	Total	30	20	50	4	3	7	1	14.0	2.0
1991	Local	21	19	40	-	3	3	-	7.5	-
	Labour	13	12	25	2	2	4	1	16.1	4.0
	Total	34	31	65	2	5	7	1	10.8	1.5
1992	Local	20	10	30	-	-	-	-	-	-
	Labour	11	9	20	-	-	-	-	-	-
	Total	31	19	50	-	-	-	-	-	-

TABLE 8: GOA: A COMPARISON OF MALARIA INFECTION IN CHILDREN (AGE 1 - 8 YRS) FROM 1990 TO 1992

Year	Status	B S C			Positive			Pf	CPR	CFR
		M	F	T	M	F	T			
1990	Local	230	227	457	33	25	58	15	12.7	3.3
(August onwards)	Labour	219	168	387	60	37	97	28	25.1	7.2
	Total	449	385	834	93	62	155	43	18.6	5.2
1991	Local	379	308	687	26	29	55	-	8.0	-
	Labour	321	214	535	52	29	81	18	15.1	3.4
	Total	700	522	1222	76	58	136	18	11.1	1.5
1992	Local	342	279	621	7	-	7	2	1.1	0.3
	Labour	138	95	233	11	3	14	1	6.0	0.4
	Total	480	374	854	18	3	21	3	2.4	0.3

alone. Thus the training of technicians engaged in the private pathological laboratories in the city is once again emphasised for the correct diagnosis and proper treatment of the cases.

IMPACT ASSESSMENT:

Vector densities: Adult densities of An. stephensi in the hand catch were always very poor and ever since the use of CDC traps adult collection has improved. The adult densities of An. stephensi were monitored by CDC trap from June 1991 onwards in both experimental and control areas. The per trap/per night densities in control area are much higher than the experimental area (Fig. 6).

Impact on vector breeding and Malaria incidence: The relationship between An. stephensi habitat positivity and malaria incidence has been shown in Fig. 7. It can be noticed that vector habitat positivity sharply increased from less than 1.0% in April to about 4.0% in June and then declined sharply in August and remained low in the remaining months of 1990. Consequently, malaria transmission picked up and MPI increased from 3 in April to 22 in July 1990 but gradually declined thereafter. Based on the findings of 1990 the vector intervention was strengthened from the beginning of 1991 to prevent the build-up from April onwards. As a result vector habitat positivity remained less than 1.0% and could not build-up. This had a desired impact on the transmission as is evident from the steep decline of the malaria incidence witnessed in 1991. In 1992, stringent intervention measures were continued. Although the vector habitat positivity increased to 1.3% in July 92 before declining, it had negligible impact on the transmission and the incidence in 1992 remained low and by and large static.

Malaria incidence in infant and children: Infant Parasite Rate (IPR) is a sensitive index and a measure of transmission in malariometry. IPR in Panaji was reported from August 1990 onwards. The comparative IPR and IFR figures are shown in Table 7, and is clearly evident that both IPR and IFR declined from 14.8% and 2% respectively in 1990 to 10.8% and 1.5% respectively in 1991. No malaria case amongst infants was reported in 1992, which indicates that there was a very good impact of intervention measures on the transmission of malaria particularly in 1992.

Similar trends were observed in the Child Parasite Rate (CPR) and Child Falciparum Rate (CFR) (Table 8). The CPR and CFR were 18.6% and 5.2% in 1990 respectively and declined to 11.1% and 1.5% in 1991. In 1992 figures were 2.4% and 0.3% respectively, which also indicates good impact on the transmission of malaria and gradual improvement in the malaria situation.

(xii) CAR NICOBAR, A & N ISLAND

Malaria was a serious problem in Car Nicobar Island. Indoor residual spraying with DDT did not interrupt transmission and the API recorded by the local Health Department was 194 in 1989. The vector Anopheles sundaicus breeds all over the island in brackish as well as fresh water.

Since the implementation of Bioenvironmental control strategy in 1989, there was a significant decline in malaria transmission every year. During the year 1992 total malaria cases were reduced by 33% and falciparum cases by 37.4% in comparison to previous year. The API was 33.0 as compared to 49.1 in 1991 (Table 1).

Construction activities, Inter-island transportation and stevedoring of materials for construction works lead to half yearly migration of labour population from three states (Orissa, Bihar and West Bengal), enhancing the transmission.

Table 2 gives the work done under bioenvironmental strategy. Filling works are in progress in low-lying areas. In creeky and marshy areas fishes are being released. Our previous report on biocide trial in these areas showed very promising results. Therefore, it has been planned to apply the biocide in order to reduce the vector population.

Biological Control : Biological control of mosquitoes continues be one of the most important component of bioenvironmental strategy. Among the biological control agents larvivorous fish occupies the foremost position. Hence an extensive fish fauna survey of Car Nicobar Island was carried out during 1992. Natural tanks and ponds are rare in this island. However, there are some ponds which were dug up during the developmental activities of this island. There are two fresh water streams flowing in the northern and southern regions. In addition to this, there are seven creeks, which contain brackish water.

Fishes collected from the ponds, streams and creeks were identified by Zoological Survey of India. Till now 16 species have been identified and some more are yet to be identified. Experiments were conducted in the laboratory to study the larvivorous potential of these fishes. If the fish consumed 100 or more larvae in 24 hours it was considered as a good larvivorous fish and graded as plus four and if the fish consumed 75, 50 and 25 larvae within 24 hours it was graded plus three, plus two and plus one respectively. Ophiocare aporos, Ophiocare

TABLE 1: CAR NICOBAR: EPIDEMIOLOGICAL DATA FROM 1988 TO 1992

YEAR	POPULATION	B.S.C	ABER	POS	Pf	Mix	SPR	SfR	API	AFI	Pf%	Rainfall
1988	19298	276770	143.4	3149	1831	33	11.38	6.60	163.2	95.0	58.0	3535.0
1989	19597	319200	162.9	3810	2392	46	11.93	7.46	194.4	121.50	62.5	2332.2
1990	20287	29279	144.3	1658	488	38	5.66	1.67	81.7	24.0	29.4	1834.8
1991	19252	20792	108.0	946	441	31	4.5	2.12	49.1	23.0	46.6	2747.5
1992	19252	17694	91.9	636	276	-	3.6	1.50	33.0	14.3	43.4	2060.2

TABLE 2: CAR NICOBAR: PROGRESS AT A GLANCE (1991-1992)

Total villages covered	19
Population protected	19252
SOURCE REDUCTION	
Margins cleaned	600
Ditches filled	64
Drains cleaned	649
Canalization	73
No.of tractor load used	40
No.of hours buldozer used	30
No. of hours tractor used	64
Construction of pond	4
BIOLOGICAL CONTROL	
Hatcheries established	4
Hatcheries maintained till date	14
Estimated number of fishes in hatcheries	2 million(app.)
Larvivorous fishes introduced, Nos.	4185000
HEALTH EDUCATION	
Health camps arranged	9
Group meetings held	1831
Health education in school	2

porocephala, Megalops Cyprinoides, Kuhlia rupestris are good larvivorous fishes. In ponds only one species Ophiocare aporos is available (Table 3). Stream fishes of this island are very interesting (Table 4). These fishes are not from fresh water fauna but are marine fishes.

Fish fauna survey is still in progress to find out the total number of species available in this area and to study their larvivorous potential.

The breeding and multiplication of the above larvivorous fishes is poor hence the large-scale culture of Gambusia affinis was carried out.

Establishment of larvivorous fish (Gambusia affinis) hatcheries: At present there are 14 established hatcheries in different

villages of Car Nicobar. Out of this 4 hatcheries are of perennial nature and others are of seasonal nature. The stock of larvivorous fish in these hatcheries is about 2 millions. During this year about 4,18,500 fishes were being introduced in different mosquito breeding habitats.

Supply of Gambusia affinis to Andaman and Nicobar Island: With the request of Deputy Director of Malaria, Andaman and Nicobar administration, Six thousand Gambusia affinis were supplied to Port Blair for the establishment of hatcheries and its subsequent release into different mosquito breeding habitats. As per the request of Deputy Commissioner, Car Nicobar. Five thousand G. affinis were also stocked in cement tank of Chowra

TABLE 3: CAR NICOBAR: LARVIVORACITY OF LOCAL FISH FAUNA

S.No.	Fish Species	Availability	Potential larvivorous
1.	Apogan hylosoma	Leas	+ +
2.	Anabus testudineus	Moderate	+ + + +
3.	Acentrogobius viridipunctatus	Moderate	+ + +
4.	Ambassis interrupta	Less	+ +
5.	Kuhlia rupestris	Moderate	+ + +
6.	Megalops cyprinoides	Moderate	+ + + +
7.	Monodactylus argenteus	Rare	+ +
8.	Ophiocara porocephala	Plenty	+ + + +
9.	Ophiocara aporos	Plenty	+ + + +
10.	Pomacentrus lividus	Rare	+ +
11.	Sphyraena obtusata	Rare	+
12.	Syngnathus spicifer	Less	-
13.	Therapan jarbua	Less	+ + +
14.	Tetradon cutcutia	Less	-
15.	Valamugil seheli	Plenty	+ + +
16.	Zenarchopterus buffonis	Less	+

TABLE 4: CAR NICOBAR: FISH FAUNA STREAM FISHES: THE FOLLOWING SPECIES OF STREAM AND POND FISHES WERE IDENTIFIED

S.No.	Fish Species	Availability
1.	Kuhlia rupestris	Moderate
2.	Ophiocara porocephala	Plenty
3.	Ophiocara aporos	Plenty
4.	Megalops cyprinoides	Moderate
POND FISH :		
1.	Ophiocara aporos	Plenty

Island and they were released in all Sintex tank, cement tanks, iron tanks and 6 wells.

Entomological Investigations : Mosquito fauna of Car Nicobar Island so far recorded consists of 12 species belonging to 6 genera which are namely Anopheles, Aedes, Armigeres, Culex, Mansonia, and Toxorhynchites. The most prevalent genus in the island is Anopheles which consist of two species viz., Anopheles sundaicus and Anopheles barbirostris.

The man hour density (MHD) of An. sundaicus recorded fortnightly from January to December 1992 from experimental and control areas is given in Table 5. This Table also reveals that the density of An. sundaicus is very low in experimental area throughout the year except during the first fortnight of December month, which was recorded 4.17 per man hour (Fig 1). In control area the species prevalent throughout the year and the density ranges from 0.5 to 55.04 per man hour. The peak density was recorded from the month of June to December.

Larval Survey: Besides the adult collections larval collections were also carried out in the island in 1992. A total of 23,149 breeding sites were surveyed in the year, out of these 142 sites support the breeding of An. sundaicus. The maximum breeding was recorded in the creek, marshy and mangrove areas. The details of breeding survey is given in Table 6.

Resting habits : Indoor day resting collection of An. sundaicus from Human dwelling, Copra machan and cattlesheds from 0600 to

TABLE 5: CAR NICOBAR: RESULTS OF MONITORING OF MOSQUITO DENSITIES

Month	Fort-night	Area with Bioenvironmental Control				Area without Bioenvironmental control			
		Mosquitoes	Culex	Anopheles	Vector	Mosquitoes	Culex	Anopheles	Vector
Jan'92	I	9.0	9.0	0.00	0.00	14.5	14.0	0.5	0.5
	II	8.0	8.0	0.00	0.00	9.5	8.0	1.5	1.5
Feb	I	12.98	12.98	0.00	0.00	15.07	0.83	14.24	14.24
	II	4.18	4.18	0.00	0.00	8.96	6.28	2.68	2.68
Mar	I	10.6	10.6	0.00	0.00	1.5	1.0	0.5	0.5
	II	3.25	3.25	0.00	0.00	1.23	1.07	0.16	0.16
Apr	I	12.00	12.00	0.00	0.00	13.20	12.40	0.80	0.80
	II	13.54	13.54	0.00	0.00	7.99	7.42	0.57	0.57
May	I	2.36	2.36	0.00	0.00	10.21	8.66	1.55	1.55
	II	7.40	7.40	0.00	0.00	6.84	5.73	1.11	1.11
Jun	I	3.16	3.16	0.00	0.00	8.18	1.87	6.31	6.31
	II	16.32	15.75	0.57	0.57	33.87	16.14	22.73	22.73
Jul	I	14.65	14.65	0.00	0.00	40.97	6.80	38.14	38.14
	II	8.72	8.72	0.00	0.00	53.09	14.97	38.12	38.12
Aug	I	11.29	11.16	0.13	0.13	38.47	13.81	24.66	24.66
	II	12.13	11.96	0.17	0.17	47.99	11.80	36.19	36.19
Sep	I	7.87	6.87	1.00	1.00	36.55	3.31	33.22	33.22
	II	2.37	2.37	0.00	0.00	18.88	10.36	8.52	8.52
Oct	I	3.68	2.93	0.75	0.75	25.20	1.20	24.00	24.00
	II	2.75	1.75	1.00	1.00	22.50	1.50	21.00	21.00
Nov	I	10.76	9.26	1.50	1.50	56.61	3.57	55.04	55.04
	II	11.24	9.37	1.87	1.87	22.41	2.76	19.65	19.65
Dec	I	10.04	5.87	4.17	4.17	29.76	2.94	26.82	26.82
	II	2.66	2.66	0.00	0.00	48.92	2.19	46.73	46.73

Total villages = 12 : Bioenvironmental strategy fully applied

Total village = 7 : Bioenvironmental strategy not applied

TABLE 6: CAR NICOBAR: ENTOMOLOGICAL SURVEY 1992

Breeding Habitat	No. survey	Anopheles	Culex	Mix	Aedes	Total
Ponds	133	26	-	-	-	-
Drains	37	5	-	-	-	26
Wells	3572	7	96	-	-	103
Marshy area	18	13	-	-	-	13
Overhead tanks	177	-	-	-	-	-
Creeks	43	24	-	-	-	-
Tanks	592	13	29	-	-	42
Steams	7	7	-	-	-	7
Creek bed pools	40	22	2	-	-	24
Ditches	274	8	36	-	-	44
Pits	81	5	1	-	-	6
Hoof print tyre	15	-	15	-	-	15
Tyres	286	2	5	-	-	7
Rain water collection	25	-	-	-	-	-
Waste water collection	643	4	232	-	-	236
Tree hole	8640	4	-	2815	-	2819
Intradomestic containers	4867	-	20	-	-	20
Cistern	209	-	3	-	-	3
Canoe	121	6	27	20	-	53
Coconut shell	2153	-	-	194	-	194
Peri-domestic containers	1215	-	28	-	-	28
	23149	142	494	3029	-	3669

0900 hrs reveals that the species prefer to rest in Copra machan than in cattlesheds and human dwellings.

The 40-50% of population rests outdoor as the collection were made from coconut stump, Keori bushes, Banana tree etc. Details of outdoor and indoor collections were given in Table 7.

Feeding Habit: During the month of December 1992 a total of 175 samples of blood meal collected from indoor resting An. sundaicus we analysed by gel diffusion method. Out of this 102 samples were found to be positive for pig (58.4%) (1.11%) for human and rest samples are positive for Bovine and goat. The result reveals that An. sundaicus was more attracted towards pig than man. Studies are in progress to assess the feeding behaviour of An. sundaicus in different season.

Insecticide susceptibility test : Insecticidal susceptibility test for adult mosquitoes were carried out with WHO test kit.

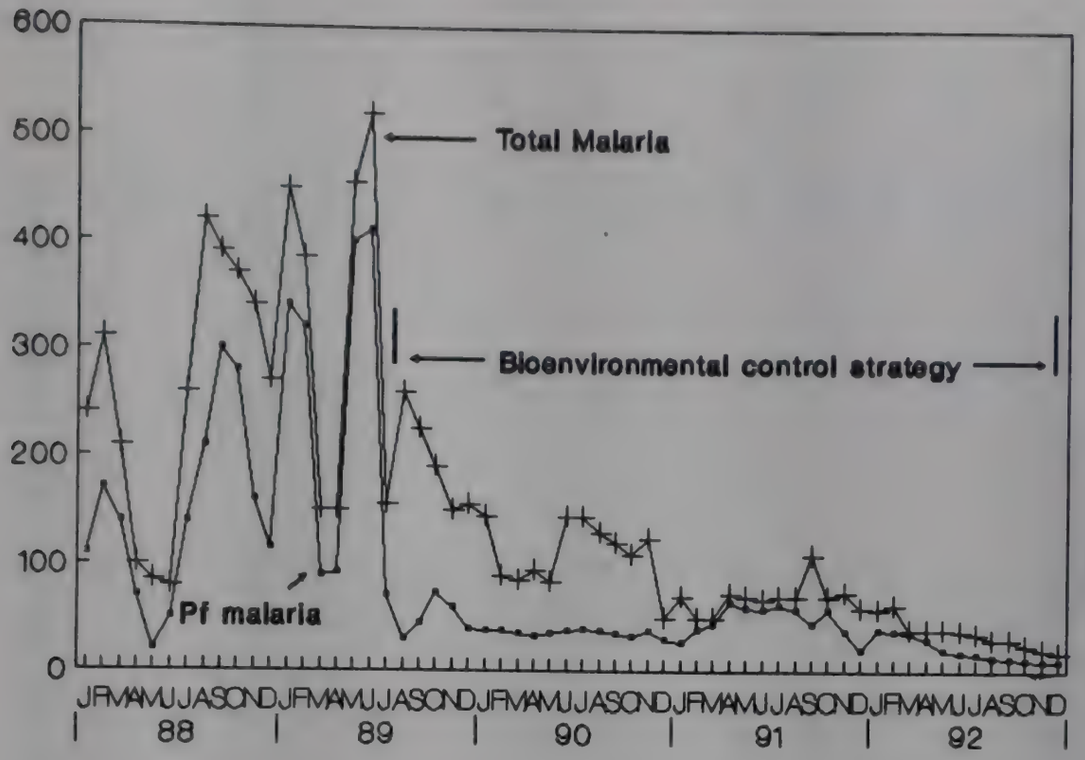


Fig. 1: Car Nicobar: Monthly total malaria and falciparum malaria in Car Nicobar Island

An. sundaicus was found to be highly susceptible to DDT whereas Culex quinquefasciatus was resistant to DDT. Result are given in Table 8.

EPIDEMIOLOGICAL:

Epidemiological results: In spite of normal rainfall this year (206 cm) the field station managed to keep the vector density sufficiently low in non creeky parts. Surveillance activities, both active and passive, are as usual done by the local NMEP unit at the Civil Hospital, Car Nicobar. The epidemiological data collected from them also show very significant reduction in total malaria as well as falciparum cases (Table 1 and Fig. 1). In comparison to previous year (1991) they were reduced by 33% and 38% respectively.

Other Research studies :

1. Response of P. falciparum to chloroquine in Car Nicobar Islands.

2. Survey of Chowra island

Response of P. falciparum to chloroquine: In-vivo chloroquine resistance test has already been conducted in this island. Out of

TABLE 7: CAR NICOBAR: DAY TIME RESTING HABITAT OF AN. SUNDAICUS

S.No.	Different structure & plant searched	No. of time searched	Female	Fed	Unfed	Semi-gravid	Gravid	Male	Total
1.	Stilt house/Hut	16	2	2	0	2	0	0	2
2.	Unused thatched hut	16	148	93	39	16	10	42	190
3.	Concrete House	15	0	0	0	0	0	0	0
4.	Coconut tree hole	16	102	34	56	9	3	10	112
5.	Holes in stumps	23	571	204	244	66	63	80	651
6.	Pamum tree	16	0	0	0	0	0	0	0
7.	Musa paradistaca (Banana tree)	26	125	61	32	17	15	17	142
8.	Pandanus Larum (Keort bushes)	54	489	239	116	46	34	87	576
9.	Barringtonia speciosa	16	0	0	0	0	0	0	0
10.	Other bushes	16	0	0	0	0	0	0	0
11.	Copra machans	37	1024	694	1640	95	71	203	1227
12.	Cattlesheds	31	703	365	121	123	94	121	824
13.	Crack and cervices	16	0	0	0	0	0	0	0
14.	Concrete calvert/bridge	16	0	0	0	0	0	0	0
	Total	315	3164	1746	772	372	290	560	3724

TABLE 8: CAR NICOBAR: INSECTICIDE SUSCEPTIBILITY TEST ON MALARIA AND FILARIA VECTOR

	Kimios (Mangroves)	Kakana (marshy)	Kimios	Kakana
Species	An. sundaicus	An. sundaicus	Cx. quinquefasciatus	Cx. quinquefasciatus
Insecticide	DDT	DDT	DDT	DDT
Diagnose (%)	4.0	4.0	4.0	4.0
Exposure period (hrs.)	1	1	1	1
No. exposed (Cont.)	100	100	100	100
No. dead (Cont.)	3	3	0.0	1
Per cent mortality (Cont.)	3.0	4.0	0.0	1.0
No. exposed (Test)	100	100	0.0	0.0
No. dead (Test)	99	100	0.0	2
Per cent mortality (Test)	99	100	0.0	2.0
Status	Susceptibility	S	R	R

73 patients tested 80.8% showed normal susceptibility to chloroquine. Eight patients (10.9%) showed poor response or RIII standard.

Survey of Chowra Island: A study team was sent to Chowra island in October 92 on the request of the local administration to conduct filariasis survey. In this preliminary survey, covering about 70% of the total population (population 1393) the microfilaria rate was 25% with the mean mf density of 13.40. On clinical examination of 201 persons acute manifestation of filariasis was detected in 57 persons (28.4%) out of which 20 persons were having gross elephantiasis, indicating the severity of the disease in this islands.

(xiii) BANGALORE, KARNATAKA

The action plan of the revised malaria control strategy of Karnataka state envisages the introduction of bioenvironmental methods. The plan stipulates (i) transfer of technology of bioenvironmental methods by MRC (ii) equipping the existing regional health and family planning centres for undertaking training programmes (iii) microlevel analysis of the malaria situation for the implementation of the revised strategy by the state govt.

In pursuance of the above objectives, a new field station of Malaria Research Centre was opened in October 92 in Bangalore city of Karnataka. The immediate task entrusted to the MRC field station was :

(i) evaluation of the existing hatcheries already established in the state and to workout additional requirements.

(ii) to undertake microlevel survey of the irrigation projects initially in stratum III, IV and V PHC and to suggest engineering methods of control for each of the irrigation projects.

This work would be taken up in a phased manner. After completion of survey work, training for district level officers of various relevant sectors would be taken up to control the breeding of mosquitoes.

Work is already in progress in Kolar district.

General information of Kolar district: Kolar district is situated on the south eastern region of the state with a population of 19,05,500 (1981 census). The district consists of 3338 villages in 11 talukas having a total area of 8223 sq km. Topographically Kolar district is having undulating hilly terrain. Average rainfall is around 600mm. Main occupation is agriculture, and sericulture has been taken up extensively as a cottage industry in the entire district.

Table 1 gives the epidemiological indices of malaria in Kolar district.

There are 60 Primary Health Centres in Kolar district divided into stratum I (32 PHCs), stratum II (20 PHCs), stratum III (2 PHCs), stratum IV (1 PHC) and stratum V (5 PHCs). Six PHCs (stratum IV & V) are most problematic as far as malaria is concerned and contribute to nearly 90% malaria cases the entire district. Out of the 6 problematic PHCs, 5 PHCs (of stratum V) are bordering Andhra Pradesh and one PHC (of stratum IV) is bordering Tamil Nadu.

TABLE 1: BANGALORE: MALARIA INDICES OF KOLAR DISTRICT

Year	Population	BSE	Positive			ABER	API	SPR	SfR
			Pv	Pf	Total				
1988	1999412	413813	794	1487	2281	20.7	1.1	0.6	0.4
1989	1999412	419653	3499	5881	9380	20.9	4.7	2.2	1.4
1990	2001015	425670	11573	12205	23778	21.2	11.9	5.6	2.9
1991	2111000	364883	8689	2155	10844	17.2	5.1	3.0	0.6
1992 *	2111000	193137	9942	3041	12983	-	-	6.7	1.6

* Data till October 92

Tanks (small reservoirs built by constructing earthen dams) are the chief source of irrigation in Kolar district. There are 3772 minor and major tanks in the district. These tanks some of which are perennial, are rainfed have small channels for irrigation. Excess water from the tanks is carried through streams/escape channels to other tanks. These irrigation tanks along with streams/escape channels,irrigation channels, paddy fields and wells etc. are the potential sources of mosquito breeding in the district.

12.3 SALIENT FEATURES OF THE REVIEW MEETING CARRIED OUT BY THE NODAL DEPARTMENT/MINISTRY

12.3.1 MINUTES OF THE MEETING OF EXECUTIVE COMMITTEE OF S & T PROJECT HELD AT MALARIA RESEARCH CENTRE, 20 MADHUBAN, DELHI ON MAY 27TH, 1992

Following members were present:

1.	Dr. V.P. Sharma	Chairman
2.	Dr. T. Adak	Member-Secretary
3.	Dr. R.C. Sharma	Nadiad
4.	Dr. R.K. Chandrahas	Madras
5.	Dr. M.M. Shukla	Jabalpur
6.	Dr. S.K. Sharma	Hardwar
7.	Dr. M.S. Malhotra	Haldwani
8.	Dr. R.S. Yadav	Rourkela
9.	Dr. R.N. Prasad	Shahjahanpur
10.	Dr. Vas Dev	Sonapur
11.	Dr. Anil Prakash	Shankargarh
12.	Dr. Ashwani Kumar	Goa
13.	Dr. A. Giri	Car Nicobar
14.	Dr. Aruna Srivastava	Delhi

Dr. M.A. Ansari, Dr. N.N. Singh, Dr. Orlov, Mr. C.P. Batra, Mr. S.C. Sharma and Mr. R.S. Daral, also attended the meeting.

Dr. V.P. Sharma, Director and Chairman of the Executive Committee welcomed the participants and invited them for presentation of highlights of their work.

Hardwar :

Dr. S.K. Sharma, highlighted the work being carried out in BHEL complex. He informed that the per cent positivity of permanent breeding sources during the period under report was 0.58. The malaria cases further reduced and the SPR rate was only 4.7%. At IDPL, Rishikesh also malaria transmission is at very low-level even after withdrawal of intervention activities. Mosquito breeding potential in the entire Hardwar district has been assessed and the breeding habitats are being mapped village wise.

At IOC Mathura P. falciparum cases have come down to 77 from 186 after the implementation of the situation specific intervention measures.

Haldwani :

Dr. M.S. Malhotra, highlighted the entomological and parasitological monitoring being carried out in irrigation project area. SPR was reported two fold higher in the vicinity of resorvoir as compared to control area. It was proposed to work on a project on rice field agro ecosystem in collaboration with Pant Nagar University.

Goa :

Dr. Ashwani Kumar, highlighted that malaria in Goa was related with construction activities. CDC light traps were found useful. Studies on demography and identification of breeding places were started. It was suggested that studies on An. stephensi distribution along the coastal area of Goa should be taken up.

Car Nicobar :

Dr. Giri, highlighted the results of ongoing studies on bio-environmental control with Gambusia and other epidemiological and entomological studies. It was found that morphological variations were there in fresh water and in saline water breeding vector populations. Chloroquine resistance has been detected in 27% cases. It was suggested to undertake biocide trials and insecticide resistance in An. sundaicus.

Shankargarh :

Dr. Anil Prakash, informed that the experimental area of Shankargarh field station was reduced from 36 villages to 16 villages. Bioenvironmental control measurs consisted of elimination of 34,283 positive breeding sites and 20 per cent breeding sites, margins of 1813 channels, introduction of larvivorous fishes, and health education. Lowest (13.3) SPR was recorded in the month of March 92 while highest (60.9) in December 91. A mobile Field Malaria Clinic was started from 1992. The problem of immigrant labourers was encountered and 63 were positive for malaria parasite.

Rourkela :

Dr. R.S. Yadav, highlighted the results of insecticide impregnated bednets in Kuarmunda PHC of Sundargarh district. It was found that treated bednets caused reduction in man-mosquito contact, vector density and malaria incidence. A new bednet study in collaboration with Ispat General Hospital, Rourkela has been launched in three iron ore mines under SAIL, where An. fluviatilis is the malaria vector. Thrust of the study will be research on various aspects as well as sustainability of bednet

intervention in other mining areas of the district along the Koenjhar-Singhbum border. A new study on riceland ecosystem has been lauched. Efforts towards transfer of bioenvironmental control technology to urban area of Orissa by involving state health programme are making good progress.

Jabalpur :

Dr. M.M. Shukla, presented the results of bednets and biocide trials. He mentioned that impregnated bednets showed reduction in experimental houses than untreated nets and control. Biocide (Bactoculicide) was found most effective upto 3 days.

It is proposed to survey some area in Bastar district to delineate information on malaria trasmission.

Shahjahanpur :

Dr. R.N. Prasad, presented the results of ongoing activities on biocide trials, biological control and ecological studies on rice field agro-ecosystems. He informed that action plan for district level implementation of bioenvironmental control of malaria is under preparation.

Sonapur :

Dr. Vas Dev, presented the results of active case detection, passive case detection and mass surveys being carried out in experimental villages of Sonapur PHC. Mass surveys resulted in SPR range from 6.84% to 26.85% maximum being in November and December.

Lambdacyhalothrin and Deltamethrin were more potent on nylon fibre as compared to cotton and jute when kept in storage upto 3 months. Use of bednet trials has been extended to Tea Gardens.

Madras:

Dr. R.K. Chandrahas, pointed out that the 7 - Point Action Plan has been taken up by Municipal Corporation, Madras. The bioenvironmental control strategy is being extended to cover the entire city of Madras.

Nadiad:

Dr. R.C. Sharma, highlighted the isolation of two bacteria and fungus for vector control. An. culicifacies was incriminated as vector. Studies are focused on forecasting of malaria and development of biological control agents. The field station is being developed as training centre of MRC.

Delhi :

Dr. T. Adak presented the results of ongoing studies on malariogenic stratification, biological control agents, especially biocide trials and fishes and relapse pattern of *P. vivax* cases. Results of biocide trials indicated that *B. sphaericus* and Bactoculicide were effective upto 3 weeks and 3 days respectively for controlling anopheles breeding. It was suggested to start the work on remote sensing.

Administrative matters :

Administrative problems of all field stations were discussed. It was advised that the Officer-in-charge should contact individually the following officers to resolve their problems. Shri. P.B. Saxena, Financial Advisor, Dr. M.A. Ansari, Deputy Director, Shri. S.C. Sharma, Administrative Officer and Shri R.S. Daral, Accounts Officer for financial, transport, administrative and accounts matters.

12.3.2 MINUTES OF THE SCIENCE AND TECHNOLOGY PROJECT ON THE INTEGRATED VECTOR CONTROL OF MALARIA HELD ON 23 SEPTEMBER 1992 IN THE COMMITTEE ROOM OF THE CENTRE, 20 MADHUBAN, NEW DELHI.

Following members were present:

Dr. V.P. Sharma	Chairman
Dr. T. Adak	Member-Secretary
Dr. M.A. Ansari	
Dr. A. Giri	
Dr. A.S. Gautam	
Dr. Indranil Kar	
Dr. Ashwani Kumar	
Dr.M.S. Malhotra	
Dr. R.N. Prasad	
Dr. R.P. Skukla	
Dr. Neeru Singh	
Dr. Aruna Srivastava	
Dr. S.K. Subbarao	
Mr. P.B. Saxena	
Mr. S.C. Sharma	
Mr. R.S. Daral	
Mr. H.D. Mamgai	

Mr. R.K. Chandrahas and Dr. V.K. Dua could not attend the meeting.

Director Dr. V.P. Sharma opened the meeting and in his introductory remarks he brought out the importance of the S&T project in light of developmental changes in various sectors of economy. He mentioned that after clearly demonstrating the control by bioenvironmental interventions in various endemic areas, he felt that time has come to re-organize research so that bioenvironmental strategy is further strengthened and outcome of field research could be pushed into the programme. In particular he mentioned that at some field stations objectives could be completely changed and ongoing work could be handed over to the state govts. The following decisions were taken.

(i) Shahjahanpur (UP): The ongoing work on bioenvironmental intervention may be terminated and areas handed over to the DMO for malaria control. Fish ponds being maintained in the district may also be handed over. In the fish ponds observations should continue on the natural survival of fishes by periodical monitoring. It was decided that 2 areas may be selected, one for the control of malaria and other for control of filariasis. Biocides (Bti and Bs) of Russian origin in combination with

fishes should be applied to see the impact on malaria and filariasis transmission.

Action: Dr. R.N. Prasad

(ii) Hardwar (U.P.): BHEL and IDPL should continue in the maintenance phase. There is a need to transfer the technology to other industrial areas and this work should continue eg. in IOC, Mathura and few other areas. A workshop should be organized for the transfer of technology. Research should be emphasized on insecticidal residues in various water bodies, organic matter and mode of action. Work on chloroquine resistance in Pf and drug uptake should continue. Baseline data may be collected on Tehri Dam particularly from Hardwar to Kanpur.

Action: Dr. V.K. Dua.

(iii) Haldwani (U.P.): Work on the bioenvironmental interventions should be stopped. Studies should be completed on the multi-purpose dam. Studies should continue on the mosquito breeding and its control in riceland agro-ecosystems.

Action: Dr. R.P. Shukla

(iv) Shankargarh (U.P.): Work on the bioenvironmental interventions should be stopped. Studies should be completed on the malariogenic stratification of Allahabad (Dr. Tiwari). There is a need to start work on migration pattern, the problem of drug resistance and testing of various control methods of biological control (Bti and Bs). The field station should shift to some other suitable endemic PHC in Allahabad and open a clinic. This facility would also be utilized for the collection of biological material. It was also decided that part of the field station should to shift to Bangalore for the transfer of technology.

Action: Dr. Anil Prakash

(v) Panjim (Goa): The work in Panjim should be in the maintenance phase to prevent build-up of malaria cases. This should be done with the help of state health department. Field station staff should emphasize on mosquito breeding potential in Konkan Railway area and suggest remedial measures. They should also study the spread of An. stephensi and set up experiments to find out reasons and route of An. stephensi invasion in Goa.

Action: Dr. Ashwani Kumar

(vi) Car Nicobar (A & N islands): Bioenvironmental interventions must be intensified to control malaria and the breeding of An. sundaicus. Advantage of the installation of sluice gates and establishment of fish hatcheries should be taken up to eliminate

breeding. Biocides (Bti and Bs) should be applied to control breeding in difficult creek areas. A complete coverage of all breeding with biocides should be maintained. The final biocide spraying should be carried out at 2 week interval until objective to control malaria is achieved.

Action: Dr. A. Giri

(vii) Kheda (Gujarat): Field station should be developed as a training centre. Larvivorous fish farm should be made operational. In field research studies should be taken up on various entomological and epidemiological aspect of Sardar Sarovar Project. Biological control of mosquito breeding should continue.

(viii) Mandla (M.P.): Bioenvironmental interventions should now be stopped and areas handed over to DMO. Field research should be diversified on Narmada Project and rice agro ecosystem.

Action : Dr. Neeru Singh.

(ix) Sonapur (Assam): Insecticide impregnated bednets should be promoted in the region through workshops and discussions. Work should continue on the biology of An. minimus, An. fluviatilis An. dirus. A few workshops on the management of serious and complicated malaria may be organized.

Action : Dr. Vas Dev

(x) Madras (TN): It was decided to continue work on the extension of bioenvironmental malaria control through Corporation to cover the entire Madras City. Madras Corporation is taking up mosquito control using biocides and field station should monitor the impact. For sibling work specimens of An. culicifacies may be collected from Rameshwaram Island and Kerala.

(xi) Rourkela (Orissa). Work on insecticide impregnated bednets should be extended to cover more mining population. A few more workshops on transfer of technology should be organized. Studies on the rice agro-ecosystem should be taken up in collaboration with agriculture department of the Rice Research Institute, Cuttack field staton should extend all possible help. Studies being initiated by the British Council in collaboration with state health department in Phulabani district, Orissa.

Action : Dr. R.S. Yadav

(xii) Delhi : In addition to the ongoing work studies on the irrigation malaria, malariogenic stratification, remote sensing, geographical information system should be intensified. There was need of the development and field testing of personal protection

methods and other appropriate and indigenous technologies for vector control. More workshops for training of engineers should be organized. Videos on various aspects of training in malariology and field research should be given priority.

Action : Dr. M.A. Ansari, Dr. R.C. Dhiman, Dr. M.S. Malhotra, Dr. Aruna Srivastava, Dr. B.N. Nagpal, Sri Raghunath Rao.

(xiii) Karnataka : A unit should become functional for the transfer of bioenvironemental malaria control technology in Bangalore. The unit will survey endemic areas, promote biological control and engineering interventions, coordinate the field work, organize transfer of technology workshops and monitor the progress of field operations.

2. Dr.S.K. Subbarao has identified certain taxonomical studies. These were discussed during the meeting and it was decided to complete the studies as suggested by her. (See Annex. 1)

Action : as indicated in Annex I

3. The following quantities of biocides would be sent to the field stations.

Goa 2 metric tonne, Car Nicobar 2 metric tonne, Hardwar 1 metric tonne, Rourkela 1 metric tonne, Delhi 2 metric tonne, Madras and Shahjahanpur to be finalized.

Action ; Dr. T. Adak

4. Dr. Neena Valecha will finalize toxicological studies on the Bti and Bs in consultation with Dr. Kulshresta and Dr. Kanungo and start toxicological studies on priority basis.

Action : Dr. Neena Valecha

5. Next review of the S&T projects would be organized early next year and work of each field station would be discussed in depth along with the study protocols.

Action : All field stations

6. Annual report of the field work related studies done during 1992 would be due in early January 1993. Detailed annual report may be prepared which should also include the future plan of work as discussed during the review meeting reference.

Action : All field stations

12.3.3 MINUTES OF THE PROJECT COMMITTEE MEETING OF THE MALARIA RESEARCH CENTRE (ICMR), HELD IN THE DHS CONFERENCE HALL ON 21 JANUARY, 1992.

Following members were present :

1. Dr. Arvind V. Salelkar, Director, DHS, Goa (Chairman).
2. Dr. V.P. Sharma, Director, MRC (ICMR), New Delhi.
3. Dr. Ashwani Kumar, Officer-in-Charge, MRC (ICMR), Field station. Goa, (Member-Secretary).
4. Dr. Sakharam Nadkarani, Deputy Director (Public Health), DHS Goa.
5. Dr. Suresh Nagarshekar, Deputy Director (Publc Health), DHS, Goa.
6. Dr. Bicaji Ghanekar, C.M.O. (NMEP), DHS, Goa.
7. Dr. R.H. Kamat, C.M.O. (NFCP), DHS, Goa.
8. Dr. Fernando Menezes, Health Officer, Panaji, Goa.
9. Dr. Aulio Lobo, Health Officer, (NMEP), DHS, Goa
10. Shri S.S. Audi, Entomologist (NFCP), DHS, Goa.
11. Shri Dias, Panaji Municipality
12. Shri Prabhu, Panaji Municipality

Shri Pukhraj Bumb, Secretary Health, and co-chairman of the committee could not attend the meeting, due to his pre-occupation.

At the outset, Dr. A.V. Salelkar, Director of Health Services, welcomed the officers present for the project committee meeting. He informed the members that a seminar on 'Vector Borne Disease' and a workshop on the 'The role of Builders and Contractors in the prevention of malaria' was organized by the Malaria Research Centre in collaboration with the Directorate of Health Services, Goa on the 20 and 21 January 1992, respectively. He recalled that there was a malaria epidemic in Panaji about 5 years ago and that with the approach followed by the MRC, the malaria cases have been brought down from about 5,000 per annum to the 1,000 mark in 1991. He insisted that under no circumstances malaria cases should be allowed to increase again. He requested the Director, MRC, Dr. V.P. Sharma, to make the field station permanent as the same had proved to be an asset for Goa. He assured that once the erstwhile vaccine institute premises are vacated, the necessary space would be made availabe to the Malaria Research Centre.

Dr. Salelkar said that Dr. Ashwani Kumar has been very cooperative with the Directorate of Health Services staff and that his team has done a lot of work. With these words of introduction, he once again welcomed the members and reiterated that MRC must continue working in Goa for further research on Malaria.

Dr. V.P. Sharma, Director, MRC, said it was his pleasure to visit Goa as the work had shown results with the joint efforts of the MRC and the Directorate of Health Service. He expressed his satisfaction at the research being done on malaria in this field station. He informed the members that there had been many instances where malaria was eliminated completely, especially in the USA and other european countries but again there was an increase in the malaria incidence. In this context he emphasised that the pressure on the malaria vector must be kept on and simultaneously awareness must be created among the public by involving voluntary agencies, social workers etc. He opined that as the malaria disease is transmitted by the Anopheles stephensi mosquito in this area, the breeding places such as overhead tanks, sumps and wells should be made mosquito proof. He also informed the members that new intervention techniques are coming up very fast for the efficient interruption of transmission. He sited the example of Deltamethrin impregnated bednets and new drugs such as Qinghaosu. WHO, he said is very keen that this new drug should be marketed at the earliest as a solution to the chloroquine resistance P. falciparum malaria. He informed the members that Dr. E.J. Pattaroyo from Columbia has invented a vaccine which provides about 80% protection against both Plasmodium falciparum and Plasmodium vivax malaria. Large-scale trials have been taken up in humans in both Columbia and Venezuala and it is quite possible that a successful antimalarial vaccine may be available soon. He suggested that since the problem in Panaji is by and large construction related, all the breeding places in the constructions have to be taken care of by being suitably treated or by avoiding stagnation of water at the construction site.

Dr. Bicaji Ghanekar informed the members about the malaria problem in Goa and presented statistics of malaria cases in Panaji and surrounding areas. He informed the members that at present malaria cases in Panaji are very much on the decline and that the problem of malaria is by and large restricted to the construction complexes at Bombolim where there was an urgent need to tackle the problem on war footing.

Dr. S.B. Nadkarani, Deputy Director of Public Health said that Taleigaon and Bombolim areas are infact very close to panaji city. He informed the members that there was by large no problem of malaria in the villages of Taleigaon and Bombolim and that the incidence was high on the Bombolim plateau where the active construction of buildings around the medical college complex was going on. He also opined that at Bombolim perhaps, new labour from endemic area is being brought by the contractors. He further added that the problem in Bombolim started towards late 1990 and became acute in early 1991. He also underlined the urgent need for proper surveillance at Bombolim, by PHC corlim in

addition to the DHS. He was also of the opinion that since there was a lot of development activity in Verem and Condolim, surveillance should be stepped up in those areas, to find out the true problem there. He stressed that there should be permanent concentration of labourers and that whenever these labourers are brought into Goa, they should be located at labour camps. He expressed concern about the fast developmental activity taking place in Patto area behind the Kadamba Bus stand and pointed out that like the Miramar area, the drainage system laid out is chocked.

Dr. Ashwani Kumar, Officer in charge of MRC, Goa field station, thanked the past Directors of Health Services viz., Dr. A. Helekar and cooperation which he said was instrumental in bringing down incidence of malaria in Panaji within such a short period of time. He also thanked Dr. S.B. Nadkarani, Dr. S. Nagarshekar, Dr. R.H. Kamat, Dr. Bicaji Ghanekar, for the cooperation rendered by them in various matters. He thanked in special way Dr. Fernando Menezes for issuing notices to many defaulters during the years 1990-91. He requested Dr. Menezes and the representatives from the municipality personnel present in the meeting to keep the pressure on the people and the PWD alike so that the mosquito proofing of the OHT's and sumps could be ensured.

Dr. V.P. Sharma suggested that the representatives of the PWD should be invited for the meeting. As regard to utility of impregnated bednets for the control of Japanese Encephalitis, Dr. Sharma was of the opinion that since the cases are by and large sporadic, the utility of impregnated bednets might be limited. He suggested that the vaccine against Japanese Encephalitis virus now available could be used in sensitive pockets.

Shri S. Audi, Entomologist, NFCP suggested that since Japanese Encephalitis has spread mostly through pigs, people rearing them should be asked to herd them in the pigsties by 1900 hr. However the other members present doubted whether this could be practically implementated.

With regard to the ammendment in the public Health Act, Dr. S.B. Nadkarani and Dr. Ashwani Kumar informed the members that the proposals had been accepted in Principle by the Government and for the framing of rules, the draft has sent by the Public Health Department to the Law Department. They also assured the members that the matter would be pursued further.

Dr. R.H. Kamat and Shri. S. Audi from NFCP, requested the Director of the Malaria Research Centre to provide the tractor and trolly for the sealing of disconnected septic tanks in the Vasco area, which was agreed in principle by the Director of the MRC.

The Officer in Charge, Dr. Ashwani Kumar, highlighted the problem of accomodation for the officers who have to be present in the field in the early hours of the day for inspection and requested the Director of Health Services, Dr. A.V. Salelkar to take up the matter with the concerned official urgently.

Dr. A.V. Salelkar assured that he would do the needful at the earliest.

The meeting concluded with the vote of thanks proposed by Dr. Ashwani Kumar, Member Secretary.

12.4 SHORTFALLS, IF ANY, AND REMEDIAL ACTION BEING TAKEN

Largely nil.

12.5 HIGHLIGHTS

12.5.1. Shankargarh, District Allahabad, UP:

Bioenvironmental interventions reduced breeding of mosquitoes; Migrant labour for quarry work were screened for malaria; and it was revealed that transmission is aggravated by labour movement from adjoining areas; Malaria clinic examined 18,062 blood smears of which 9367 were found positive (SPR=51.9% and Pf% = 63.2%); and Pf resistant cases were frequently encountered in the migratory population, which was perhaps the main source of dissemination of new parasite strains.

12.5.2 BHEL, IDPL & Urban areas, District Hardwar , UP:

Malaria cases have been successfully controlled at the BHEL and IDPL complexes and indigenous transmission has been interrupted; At Indian Oil Refinery, Mathura there was major reduction in transmission, neem oil was very effective in repelling anophelines and aedes; HPLC method was developed for the correlation of drug in the blood and in-vivo parasite response; insecticide residue analysis studies in various organic substances showed high level of HCH, and residues were detected in the rainwater.

12.5.3 Haldwani, District Nainital, UP:

Studies on irrigation malaria revealed that malaria transmission was very high near the reservoir; rice agro-ecosystems support the breeding of malaria vectors An. culicifacies, An. fluviatilis and An. annularis; notonectid bugs were very useful in the control of mosquito breeding in some selected habitats; relapse rate in P. vivax was 44.8% and with 5 day radical treatment 14.0%; there is an increasing trend of malaria in the region; and presence of mf carriers (75% from Deoria and 25% from districts of Bihar). Haldwani is likely to become endemic for filariasis.

12.5.4 District Shahjahanpur, UP:

An outbreak of malaria was investigated in Baniyani village of Farrukhabad district; preliminary trials with Bti and Bs showed highly encouraging results; chloroquine resistance in P. falciparum (63% were resistant); high transmission of

filariasis in certain villages of the district; widespread epidemic of dengue haemorrhagic fever and its extension to some rural areas; and establishment of 2 units to test the bio-larvicides in the control of transmission of malaria and filariasis.

12.5.5 Nadiad, District Kheda, Gujarat:

Studies revealed 12.26% relapse rate in P. vivax and after 5 day radical treatment the relapse rate was reduced to 1.0%; chloroquine resistance in P. falciparum was: RI 10.8%, RII 3.2% and RIII 9.4%; a high proportion of asymptomatic carriers in rural areas of Kheda with SPR 8.4% against the SPR of 15.5% in fever cases; breeding of Ae. aegypti (vector of dengue) and An. stephensi (vector of malaria) in the wells and intradomestic containers in villages as a result of piped water supply; and control of mosquito breeding (both Anopheles and Culex) upto 4 weeks with Bs and Bti in the field.

12.5.6 Delhi, UT:

Preparation of a master action plan to control malaria and other vector borne diseases; field trials with bio-larvicides produced very encouraging results; malariogenic stratification of Delhi; production and supply of larvivorous fishes; tests with the repellent action of neem oil against mosquitoes and sandfly; remote sensing to map mosquito breeding; preparation of video films for teaching and training purposes.

12.5.7 Madras, TN:

Mosquito breeding in the overhead tanks and wells in 3 Corporation divisions is being maintained at low levels and 3 Corporation divisions have been handed over to the Municipal Corporation for maintenance; 7 point action plan to control malaria is being implemented by the Madras Municipal Corporation and; large-scale biolarvicide trials are in progress to control mosquito breeding in the city.

12.5.8 Mandla, MP:

Studies on bioenvironmental interventions reduced vector breeding habitats and there was adverse impact on adult densities, malaria transmission was also reduced due to interventions; insecticide impregnated bednets were not very effective due to early biting habits of the vector(s) and outdoor life style of the tribal population; and impregnated curtains have produced good impact on malaria transmission compared to bednets.

12.5.9 Sonapur, District Kamrup, Assam:

An. minimus has emerged as a major problem vector in the NE region and insecticide impregnated bednets were very effective in controlling malaria in Assam; malaria surveys in tea gardens showed high transmission in some areas resulting in high morbidity and deaths due to malaria; presence of chloroquine resistant strains RI (4%) RII (2%) and RIII (2%); 3 workshops were organized for the management of serious and complicated malaria, the impact of training was visible in better management of cases.

12.5.10 Rourkela, District Sundergarh, Orissa:

Insecticide impregnated bednet experiments have successfully controlled malaria among 13,000 mining population. Bednets have become very popular and there is a great demand from other mining areas. A big field trial on bednets is envisaged in collaboration with state health department and ODA; studies on the quartan (P. malariae) revealed that malaria does not cause nephrotic syndrome in Rourkela as has been reported from other areas; studies on breeding association of mosquitoes in rice agro-system revealed the presence of 15 culicines and 16 anophelines including the vectors of malaria, filaria and JE.

12.5.11 Car Nicobar (Andaman & Nicobar Islands):

Larvivorous fish fauna was investigated; Gambusia has been mass produced and applied to control An. sundaicus breeding; areas with bioenvironmental control have very low mosquito (3-10 MHD) and vector densities (Zero) as against in the control upto 48 MHD and 38 MHD of the vector; there is a consistent decline in transmission as a result of bioenvironmental interventions e.g. 1989 API was 11.93 and gradually reduced to 5.66, 4.5 and 3.6 in 1992.

12.5.12 Goa:

Malaria has been successfully controlled in Panjim by the application of bioenvironmental methods and it has been handed over to the health department for maintenance; Surveys along the Konkan Railways revealed high mosquitogenic potential and intervention strategies are being worked out. Biolarvicides produced effective control of An. stephensi for 4-5 weeks; training workshops for engineers have been helpful in extending the strategy; and course curriculum has been amended to include teaching of malaria at the school level.

12.5.13 Bangalore, Karnataka:

A unit has been established for the transfer of technology to control malaria using bioenvironmental method, the unit is at present engaged in geographical reconnaissance of malarious areas and preparation of action plan to be implemented by the state health department.

12.6 RESEARCH PAPERS PUBLISHED/CONTRIBUTED DURING THE PERIOD UNDER REVIEW

Gujarat, model of health management information system with reference to malaria by R.C. Sharma, H.M. Thaker, A.S. Gautam, R.M. Bhatt and D.K. Gupta. Ind. J. Malariol., 29: 11-22.

Intradomestic mosquito breeding sources and their management by D.K. Gupta, R.M. Bhatt, R.C. Sharma, A.S. Gautam and Rajnikant. Ind. J. Malariol., 29: 41-46.

Anopheline breeding in ponds of central Gujarat with reference to water hyacinth infestation by Rajnikant, R.M. Bhatt, R.C. Sharma, D.K. Gupta and A.S. Gautam. Ind. J. Malariol., 29: 57-61.

Sensitivity of mosquito-pathogenic bacterial strains to various antibiotics by D.K. Gupta, R.C. Sharma, R.M. Bhatt and A.S. Gautam. Ind. J. Exp. Bio., 30: 915-917.

Microscopic diagnosis of malaria in Kheda district of Gujarat by A.S. Gautam, R.C. Sharma, R.M. Bhatt and D.K. Gupta. Ind. J. Malariol., 29: 83-87.

Frequency of ABO blood groups, sickle-cell haemoglobin, G-6-PD deficiency and their relation with malaria in scheduled castes and scheduled tribes of Kheda district, Gujarat by C.S. Pant, D.K. Gupta, R.C. Sharma, A.S. Gautam and R.M. Bhatt. Ind. J. Malariol., 29: 235-239.

JSB versus Giemsa stain: an evaluation by A.S. Gautam, R.C. Sharma, R.M. Bhatt and D.K. Gupta. Ind. J. Malariol., 29: 251-253.

Report of three cases of P. falciparum showing moderately high parasitaemia by Neeru Singh, M.M. Shukla and N. Valecha. Ind. J. Malariol., 29: 199-201.

Delayed mortality and morphogenetic anomalies induced in Culex quinquefasciatus by the microbial control agent Bacillus sphaericus by M.S. Mulla, Neeru Singh and H.A. Darwazeh. J. Amer. Mosq. Contr. Assoc., 7(3) 412-419.

Enhancing the efficacy of Gambusia affinis to control mosquito breeding in ponds by M.S.Malhotra and Anil Prakash. Ind. J. Malariol., 29: 65-68.

Fishes of District Sundargarh, Orissa, with special reference to their potential in mosquito control by R.S. Yadav, K. Pradhan and V.P. Sharma. Ind. J. Malariol., 29: 225-233.

Sensitivity status of P. falciparum to chloroquine, amodiaquine, quinine, mefloquine and sulfadoxine/pyrimethamine in a tribal population of District Sundargarh, Orissa by S.K. Ghosh, R.S. Yadav and V.P. Sharma. Ind. J. Malariol., 29: 211-218.

Breeding habitats and their contribution to Anopheles stephensi in Panaji by Ashwani Kumar and D. Thavaselvam. Ind. J. Malariol., 29(1): 35-40.

Malaria epidemic in Baniyani village district Farrukhabad (U.P.) by R.N. Prasad, K.J. Virk, T. Sharma and G.D.P. Dutta. Ind. J. Malariol., 29: 219-224.

Water mite (Arrenurus species) parasiting mosquitoes in Shahjahanpur (U.P.) by S.N. Sharma and R.N. Prasad. Ind. J. Malariol., 29: 255-258.

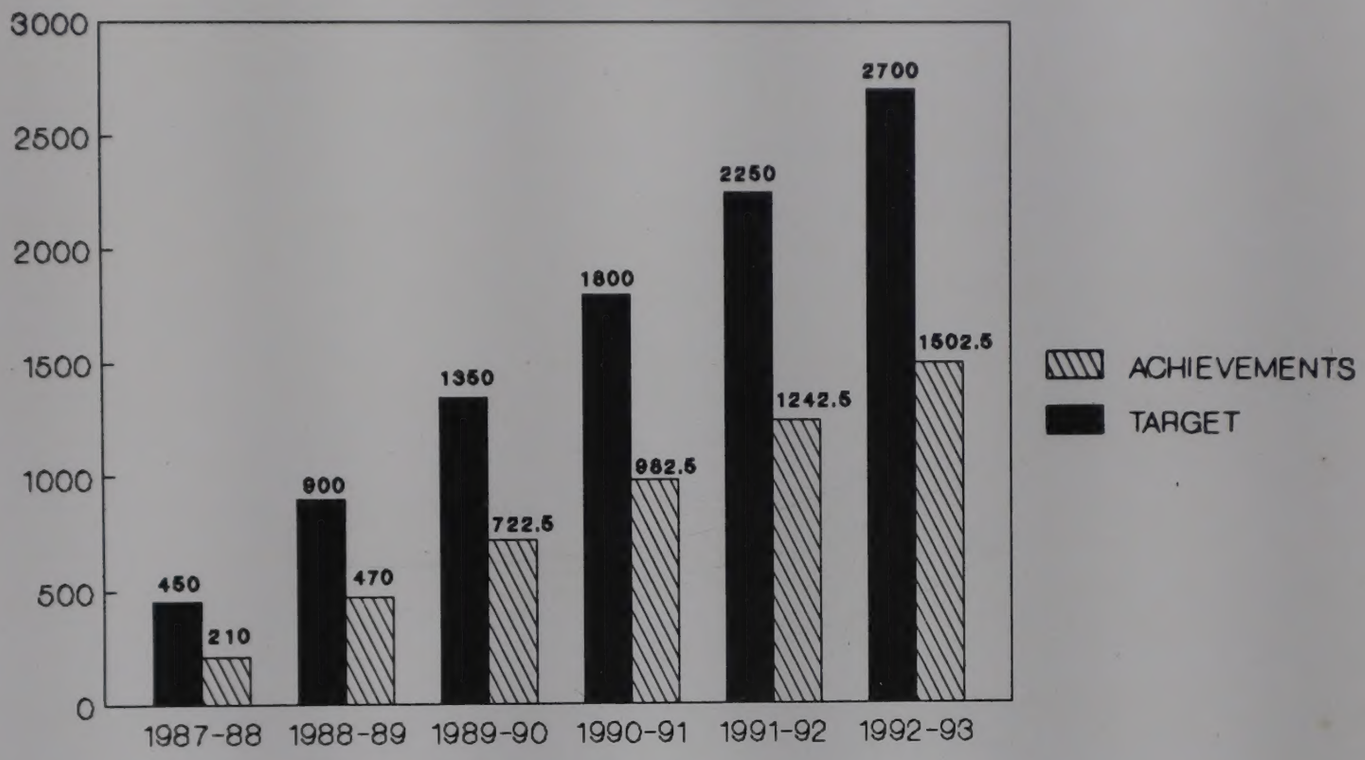
Gambusia affinis dispersal due to floods and its failure to colonize new water bodies in Shahjahanpur district (U.P.) by S. Haq, R.N. Prasad, H. Prasad and R.P. Shukla. Ind. J. Malariol., 29: 113-118.

Anopheles minimus in Assam by Wajihullah, B. Jana, and V.P. Sharma. Cur. Sci., 63: 7-9.

PART III (PHYSICAL TARGETS)

13. Targets for Jan-Dec'93

Quarterly financial targets for 1992-93 are shown below:



Yearly cumulative targets and achievements since 1987

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